SCIENCE ABSTRACTS

SECTION A

PHYSICS.

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VI and VII almost vanishes owing to the formation of very stable molecules in the gaseous state, and sometimes also of molecular crystals of the solid. H. H. Ho.

2536. The stoichiometric association of dipolar molecules in solutions. H. Dunken. *Zeits. f. phys. Chem. B*, **45**, 3, *pp.* 201–215, 1940.—It is shown by means of examples that the association of dipolar molecules in solvents having no dipole, as demonstrated by osmotic measurements, obeys the law of mass effect. S. G. B.

***2537. A chemical detector for molecular beams.** J. H. Simons and J. Glasser. *J. Chem. Phys.*, **8**, *pp.* 547–550, *July*, 1940.—A thin film of Te has been found satisfactory as a detector plate for atomic H, O, Cl, and B, and offers promise for organic free radicals. By a method of intensification with the use of positive development a high sensitivity is obtained. The technique of the preparation, use and development, of this detector is given. A list of possible uses is included. Authors.

See also Abstracts 2558, 2624, 2625, 2640, 2645, 2670, 2672, 2703.

COLLOIDS.

2538. The electrothermal dispersion of metals. E. Einecke. *Kolloid Zeits.*, **90**, *pp.* 196–201, *Feb.*, 1940.—A new process for electric sputtering of metals is described, the essential principle of which is the use of shot-like material which is agitated whilst the current is being passed. Cu, Mg, Zn, Al, Pb and Fe, were dispersed in various liquids in the form of such "shot-electrodes". Variations in the concentration of electro-copper, and Zn hydrosols and Al alcosols, prepared in this manner, were investigated in relation to the time of dispersion or sputtering. The flaking of electro-aluminium alcosols on addition of ligroin is also studied, S. G. B.

2539. Optical analysis of the deformation of isotropic cellulose hydrate threads by means of polarization effects. P. H. Hermans and P. Platzek. *Zeits. f. phys. Chem. A*, **185**, 4, *pp.* 260–306, 1939.—Using the method of anisotropic swelling, results from previous experiments were used to determine the process of orientation as a function of extension in isotropic cellulose hydrate threads or filaments in different stages of swelling produced by different methods. It is found that these results are in agreement with the value of the specific double refraction of the dry material. The optical polarization reaction of swollen cellulose hydrate filaments previously subjected to increased degrees of stretching is studied by taking their double-refraction curves. The curve shapes vary according to the liquid of imbibition used. S. G. B.

2540. Wood-water relationships. Part V. The hydrostatic compressibility of the wood-water aggregate. W. W. Barkas. *Faraday Soc., Trans.*, **36**, *pp.* 824–834, *Aug.*, 1940.—Making use of an empirical observation on the change of vapour pressure of solutions with pressure, as calculated by Porter's osmotic-pressure equation, it has been possible to calculate the specific volume of water in tension. Assuming that the above observation is equally applicable to hygroscopic gels, complete pressure/volume curves for the wood-water aggregate of sitka spruce at all moisture contents have been constructed, covering a wide range of pressures and tensions. The results are compared with those obtained on the saturated aggregate by Volbehr, who used a method of calculation which did not involve a knowledge of the vapour pressure. [See Abstract 1519 (1939).] Author.

2541. The scientific and technical meaning of aerosols. F. Müller. *Kolloid Zeits*, **90**, *pp.* 1–10, *Jan.*, 1940.—A review of the present position and literature of the subject. Details are given of an experimental technique for observation of the phenomena involved. A comprehensive Bibliography is appended. S. G. B.

2542. Hevea latex: effect of proteins and electrolytes on colloidal behaviour. A. R. Kemp and W. G. Straitiff. *J. Phys. Chem.*, **44**, *pp.* 788–808, *June*, 1940.—Three protein fractions have been isolated from fresh and ammoniated latex serum. The usual colour and precipitation reactions placed these proteins in the classification of conjugated glycoproteins. Proteins from fresh latex differ in composition from, and are less sensitive to coagulating influences than, the proteins from ammonia preserved latex. Coagulation tests using latex coagulants were performed on the protein hydrosols; it was found that, as the concentration of electrolytes decreased, coagulation of the proteins was inhibited, whereas coagulation readily took place when salts were present in sufficient concentration. Normal ammoniated latex has been subjected to extensive dialytic treatment in specially constructed apparatus; as the ash content of the total solids from the latex approached a value of 0·1%, the mechanical stability decreased and the chemical stability increased; addition of excess acid or alkali to dialysed latex yielded stable latices which were highly resistant to spontaneous coagulation. Quantitative coagulation studies, using methyl alcohol and salts of varying types and made on dialysed latex adjusted to various *p*H conditions, showed that small amounts of a dissolved salt greatly aided coagulation. Considerable variation in the effectiveness of different salts was found. H. H. Ho.

2543. Clay-water relationships. H. H. Macey. *Phys. Soc., Proc.*, **52**, *pp.* 625–656, *Sept.*, 1940.—It is shown that, if the plastic mixture of clay and water be subjected to a steady pressure between porous pistons, the applied pressure P is related to the equilibrium moisture-content M by the expression $P = \alpha e^{-\beta M}$, and the aqueous conductivity C obeys a similar relation $C = \theta e^{\varphi M}$. The validity of the assumption, that the water movement during drying is associated with the pressure P, and that of the extrapolation of the empirical formulae for P and C to moisture contents below those possible experimentally, is demonstrated by a comparison of experimental and calculated moisture-content distributions in clay bars drying from one end only. The variation in C cannot be explained if the viscosity of the water in the mixture is the same as that in bulk, but the experimental data on a wide range of clays are in agreement with the supposition of an anomalous viscosity, very large at the solid/liquid interface and decreasing exponentially with distance from that interface. This is attributed to an intensity of crystal structure in the water which decreases from the interface in a similar manner. Author.

2544. The sediment volumes and speed of sedimentation of poly-disperse kaolin, quartz and soil powders, in electrolyte solutions. Part I. G. G. Kandilarow. *Kolloid Zeits.*, **90**, *pp* 320–340, *March*, 1940.—A determination of the influence of the nature, valency and concentration, of the ions on the sedimentation of soil particles, both the sediment volumes and the speed of sedimentation being considered. The greatest variation, dependent on the nature and concentration of the salt solutions used, is displayed in the case of poly-disperse kaolin powder, due to the extremely large inner surface of kaolin. S. G. B.

2545. Electrokinetic experiments with natural silk. Part II. The ζ-potential of silk boiled in water in relation to mixtures of acetone and water and ethyl alcohol and water. T. TAKADA AND K. KANAMARU. *Kolloid Zeits.*, **90**, *pp.* 178–183, *Feb.*, 1940.—[See Abstract 2281 (1939).] Experiments were made to determine the ζ-potential of silk boiled in water in conjunction with various mixtures of water and acetone or ethyl alcohol, and the variation of the ζ-potential in the course of time. There is a strong deviation from the normal course of the ζ-potential curve in the case of a combination of the acetone/water and the ethyl alcohol/water mixture in which a free amino acid, as found by titration, behaves like a simple base or acid, respectively. The experimental results indicate that not only the ion double layer, but also the dipolar double layer, participates in the generation of the ζ-potential on the boundary surface of natural silk in conjunction with a mixture of water and acetone or alcohol. The free amino-acids are present in the natural silk. S. G. B.

2546. The lowering of the viscosity of nitrocellulose. Electrokinetic investigations into the lyophilic properties of cellulose derivatives. K. KANAMARU, T. TAKADA AND E. WADA. *Kolloid Zeits.*, **90**, *pp.* 183–189, *Feb.*, 1940.—[See Abstract 896 (1939).] The alteration of the ζ-potential and the amount of sorption of nitrocellulose in conjunction with certain polar liquids were studied in relation to the duration of heating the nitrocellulose under pressure in water. It was found that the ζ-potential of nitrocellulose after immersion of the sample, and the relative decrease of the ζ-potential, increase with the time of boiling and with the decrease of viscosity. These results are in accordance with the theory of lyophily in the solid phase in view of the fact that the sol-forming capacity of a nitrocellulose in such polar liquids as water or ethyl alcohol increases with the boiling time and the decrease of viscosity. S. G. B.

2547. The electrokinetic potential of cellulose and its derivatives. K. KANAMARU AND T. TAKADA. *Kolloid Zeits.*, **90**, *pp.* 315–319, *March*, 1940.—An account of results of further investigations relating to ζ-potential of cellulose in various cellulose derivatives and the alteration of ζ-potential in the course of time. A new method of measurement is established in confirmation of earlier results. [Abstract 2680 (1939).] S. G. B.

2548. The ζ-potential at the boundary surface between solids and water, in relation to the internal micellar or crystalline structure of the solid. K. KANAMARU AND T. TAKADA. *Zeits. f. phys. Chem. A*, **186**, 1, *pp.* 1–9, 1940.—The influence of the degree of orientation of the micellae on the ζ-potential of samples of rayon produced at various spinning speeds is studied. In the case of those samples spun at low speeds, i.e. samples with less parallelism of the crystallites, the initial ζ-potential is higher, the equilibrium value is less and, consequently, the relative decrease of ζ-potential greater than for the sample produced by high-speed spinning. [See Abstract 2680 (1939).] S. G. B.

2549. Investigations of surface conductivity. Part I. The surface conductivity of cellulose and its derivatives in relation to its lyophily. K. KANAMARU AND T. TAKADA. *Zeits. f. phys. Chem. A*, **186**, 1, *pp.* 10–18, 1940.—The surface conductivity on the boundary surface of nitrocellulose and of glass in certain polar liquids (water, methyl and ethyl alcohol) and its modification in the course of time, dependent upon the swelling capacity of the material, is measured. The process of sol formation on

the boundary surface has a great influence upon the surface conductivity and its subsequent modification on ageing. The results show that the phenomenon of surface conductivity arises not only in the ion double layer but also in the dipolar layer on the boundary surface. S. G. B.

2550. The iso-electric point of gelatine. E. C. E. Hunter and A. J. Turner. *Faraday Soc., Trans.*, **36**, *pp.* 835–839, *Aug.*, 1940.—The iso-electric points of a series of (*a*) acid-treated and (*b*) limed gelatines have been measured. Acid-treated gelatines have iso-electric points between *p*H 6–7; limed gelatines have iso-electric points at the normal range of *p*H 4·8–5·0. Authors.

2551. The effect of certain potassium salts on the electrophoretic mobility of cetyl acetate emulsions, and on the interfacial tension between cetyl acetate and water. W. Dickinson. *Faraday Soc., Trans.*, **36**, *pp.* 839–846, *Aug.*, 1940.—The effect of KCl, KI and KCNS, upon the electrophoretic mobility of cetyl acetate emulsions has been investigated at constant H-ion activity (*p*H = 4·0), and at 25°C. The mobility, when plotted against the concentration of KCl, gives rise to a " normal " type of curve. The curves relating the mobility with the concentration of KI and KCNS are of a more unusual type. In the case of KCNS the mobility increases over the whole concentration range studied, while the curve for KI possesses an unusually pronounced maximum. Over the concentration range investigated the mobility in the presence of KI is greater than the mobility in the presence of KCNS solutions of the same normality, presumably indicating that iodide ions are more heavily adsorbed throughout this concentration range. On extrapolating the curves the order appears to be reversed above a concentration of about 160 millimolar. Corresponding measurements have been carried out on the effect of KCl, KI and KCNS, on the interfacial tension between cetyl acetate and water. Certain resemblances between the interfacial tension and the electrophoretic data are pointed out. Author.

2552. The orientation of the crystallites in fibre cellulose. E. Plötze and H. Person. *Zeits. f. phys. Chem. B*, **45**, 3, *pp.* 193–200, 1940.—X-ray examination of polymeric homologous series of disintegrated native fibre cellulose showed that the structural quality, i.e. the radial width of the so-called blackening curve taken along a Debye ring, remains constant for each series. S. G. B.

2553. The determination of the shape and size distribution in gold colloids. B. v. Borries and G. A. Kausche. *Kolloid Zeits.*, **90**, *pp.* 132–141, *Feb.*, 1940.—It is shown that in super-microscopic photographs of sharp-cornered particles photographical error causes the corners to appear rounded. In pictures of colloidal gold particles having the shape of regular triangles, hexagons, rhombs and squares, are found. Octagons sometimes occur. It is concluded that the basic form of the particles examined is the octahedron, but cube surfaces may appear at the corners. The distribution of shapes and sizes in various colloid solutions of gold was determined by measurements of super-microscopic photographs. The distribution of sizes of diameter of the gold particles conforms with the Gauss distribution. In respect of surface and weight agreement is less close. The size distribution curve showed that one of the gold colloid solutions examined consisted of a mixture of 2 portions differing in size. S. G. B.

See also Abstracts 2677, 2678.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

2554. A short table of quantities used in computations for cubic space lattices. L. W. McKeehan. *J. Chem. Phys.*, **8**, *pp.* 567–568, *July*, 1940.

2555. Finite complexes in crystals: a classification and review. A. F. Wells. *Phil. Mag.*, **30**, *pp.* 103–134, *Aug.*, 1940.—In crystals throughout which the interatomic binding is not uniformly of one type we may distinguish aggregates of atoms within which the binding is of one kind whereas that between one aggregate and the next is of a different nature. Such groups of atoms may be finite (molecules and complex ions) or they may extend throughout the crystal as infinite chains or layers. The first part of the present paper deals with the classification of such finite complexes. This is followed by a comprehensive survey of finite complexes, and the paper concludes with a short discussion of the constitution of the heteropolyacids. Author.

2556. Fundamental relation between lattice constants and density. F. Foote and E. R. Jette. *Phys. Rev.*, **58**, *pp.* 81–86, *July* 1, 1940.—It is proposed that a unit called the "crystal ångström" be defined as follows: 1 crystal ångström = 1 $Å_{cr}$ = 10^3 *X* units, and be used in crystal structure work where "crystal wavelengths" are used. 1 $Å_{cr}$ is not equal to 10^{-8} cm. It is proposed that the fundamental density equation be rewritten in the form $\rho = K(nM/V')$ where n = No. of atoms or molecules in the unit cell, M = atomic or molecular weight and V' = volume of the unit cell in crystal ångströms. The constant K is evaluated empirically from data on calcite and is found to be equal to $1{\cdot}650_{23} \pm 0{\cdot}000\,15$ where $0{\cdot}000\,15$ is the calculated value of the standard deviation. This is the only value which is consistent with (1) the basis for the crystal wavelength scale adopted by Siegbahn, namely $d_{100} = 3{\cdot}029\,45$ $Å_{cr}$ = $3\,029{\cdot}45$ *X* units at 18°C. for the cleavage cell of calcite, and (2) the best available values for the atomic weight, density and rhombohedral angle, of calcite. This value of K must be used in calculating densities from lattice constants if crystal wavelengths are used. Density calculations are made for 5 metals and compared with directly measured densities. The error in the calculated density attributable to errors in lattice constant measurements is generally smaller than those due to the atomic weights and to K. For Al, Mg and Ni excellent agreement is obtained between the calculated and measured densities. For Cu and Ag there is marked disagreement, but since the directly measured densities are far from concordant while the lattice constants of various investigators agree closely, it is concluded that the main source of the discrepancy lies in the directly measured values. Authors.

2557. Crystal structure of cementite, Fe_3C. H. Lipson and N. J. Petch. *Iron and Steel Inst., J.*, [9 *pp.*], 1940. *Paper to be read at Sept. meeting.*—Previous workers on the structure of cementite have located the iron atoms accurately but have failed to detect the C atoms. On the basis of space available, 2 alternative sets of sites are possible; one of these is more probable, as it agrees better with the usual size of the carbon atom. By direct calculation of the electron density in 2 different planes in the unit cell, using accurately measured intensities of X-ray reflection, the authors have found the positions of the C atoms. They agree well with the more probable of the 2 sets of positions previously

suggested. A description of the structure is given, with a discussion of its possible relation to the structures of ferritic and austenitic iron. AUTHORS.

2558. Theoretical atomic distribution curve for liquid argon at 90° K. G. S. RUSHBROOKE. *Roy. Soc. Edinburgh, Proc.*, **60,** 2, *pp.* 182–191, 1939–1940.—The first peak in the atomic distribution curve of liquid A at 90° K. is calculated on the basis of Lennard-Jones and Devonshire's model for the liquid state of the inert gases. The temperature was chosen as being sufficiently near the freezing point for the concept of co-ordination shells within the liquid to have meaning. The peak is compared with that deduced theoretically by Wall and is found to follow it closely. The results of attempts to construct a complete distribution curve by making 2 alternative further assumptions about the structure of the liquid are also given. A. J. M.

2559. The electrolytic growth of ionic crystals. A. R. UBBELOHDE. *Faraday Soc., Trans.*, **36,** *pp.* 863–867, *Aug.*, 1940.—Experiments are described to illustrate the phenomenon of electrolytic growth, in which supersaturated solutions of salts begin to deposit crystals at one of the electrodes when a small current is passed. In the discussion reference is made to the mechanism of ionic discharge, to the migration of possible ionic clusters in solution and to the biological importance of a mechanism for directing the deposition of crystals from supersaturated solutions. AUTHOR.

2560. Growth conditions for single and optically mosaic crystals of Zn. C. A. CINNAMON AND A. B. MARTIN. *J. of Applied Physics*, **11,** *pp.* 487–490, *July*, 1940.—A modified Kapitza method used in the study of conditions favourable to the growth of single crystals of Zn (99·99$^+$% pure), shows that the ratio of the temperature gradient (across the interfacial boundary between the liquid and solid phases) to the rate of growth of the crystal must be maintained within an optimum range of values, depending on the angle of orientation. Optically mosaic crystals give no indication of a preferred region of growth and can be obtained over a much wider range of conditions. AUTHORS.

See also Abstract 2588.

DENSITY.

See Abstracts 2556, 2683.

DIFFUSION AND OSMOSIS.

2561. Diffusion in crystal ions. E. WIETIG. *Zeits. f. phys. Chem. B*, **45,** 5, *pp.* 374–388, 1940.—A method is described for the investigation of pure diffusion processes in crystals of Ba salts. An easily soluble and a difficultly soluble Ba salt are mixed. In one of these an isomorphous radioactive indicator is incorporated. After diffusion the 2 salts are again separated by solution. The migration of the indicator is taken as the measure of the amount of diffusion of the Ba ions. S. G. B.

2562. Flow of a gas through porous media. J. L. FOWLER AND K. L. HERTEL. *J. of Applied Physics*, **11,** *pp.* 496–502, *July*, 1940.—Kozeny's approximate solution to the problem of fluid flow through porous media is developed and the result is checked by experimental data on air flow through plugs of cotton wool, rayon and glass wool fibres. The solution gives an expression for the isothermal linear flow of a gas. AUTHORS.

2563. The diffusion of hydrogen and of deuterium in palladium. W. JOST AND A. WIDMANN. *Zeits. f. phys. Chem. B*, **45**, 4, *pp.* 285–296, 1940.—The method of investigation of the diffusion of H in Pd and the fundamental difficulties experienced in taking precise measurements are described. The ratio of the diffusion coefficients of H and of D in Pd is found to be $> \sqrt{2}$. This figure is discussed in relation to the fact that a difference must exist in the Pd lattice which should affect the heat of activation involved in the change of position and increase the above ratio. S. G. B.

2564. The kinetic interpretation of osmotic pressure. W. V. METCALF. *Kolloid Zeits.*, **90**, *pp.* 11–16, *Jan.*, 1940.—The existing theories being considered inadequate a theory of the balance of pressure is suggested and the following conclusions reached. The force causing the liquid to rise in a tube is the diffusion pressure of the solute which reacts with the excess diffusion pressure of the solvent on the side of the membrane next to the pure solvent. The transmission of the solvent through the membrane is due to the excess pressure of the solvent on the pure solvent side. The force exerted outwards on the membrane is the diffusion pressure of the solute and this force also maintains the hydrostatic excess pressure on the solution side, the increased diffusion pressure of the solvent on the other side ceasing to exist as soon as a state of equilibrium is reached. S. G. B.

2565. Methods of determination of the maximum pore diameter in filters. H. KNÖLL. *Kolloid Zeits.*, **90**, *pp.* 189–194, *Feb.*, 1940.—Bechold's bubble-pressure method does not give the real diameter for the determination of the maximum pore diameter of filters. There is no basis for Schurmann's hypothesis that the gas bubbles produced by fine filters during the bubble pressure process are formed by the combination of microscopic bubbles emerging simultaneously from neighbouring pores. S. G. B.

2566. Filters of known equal pore diameter with the dimensions of colloidal particles. J. BERNDEL. *Kolloid Zeits.*, **90**, *pp.* 194–195, *Feb.*, 1940.—This method facilitates the production from any suitable material of rods of any desired length with longitudinal pores. The number of pores and their diameter can be varied at will. By removing portions perpendicularly to the length axis sieves, sprinklers and filters, with pore diameter of the dimensions of colloidal particles are obtained. The path of the pores through the filter wall is straight. The filters are made of glass and full technical details are given. S. G. B.

See also Abstracts 2536, 2608.

ELASTICITY AND PLASTICITY.

2567. The theory of plasticity of the isotropic body. Y. NAKAGAWA. *Ryojun Coll. Eng., Mem.*, **13**, *pp.* 22–193, *March*, 1940. *In Japanese with a résumé in German.*

2568. A simple method of finding Poisson's ratio. M. D. WALLER. *Phys. Soc., Proc.*, **52**, *pp.* 710–713, *Sept.*, 1940.—The paper describes how Poisson's ratio can be measured in terms of the ratio of 2 specified natural frequencies of a vibrating free square plate. Results for glass, steel, brass, copper and aluminium, are given. It is suggested that such a simple method of estimating this elastic constant might be of value in the mechanical testing of metals and alloys. AUTHOR.

***2569. A complete photo-elastic instrument.** F. W. BUBB. *J.O.S.A.*, **30**, *pp.* 297–298, *July*, 1940.—Describes an adaptation of Michelson's interferometer designed to provide a photograph of the contour lines for any transparent plane test model under plane stress. The instrument employs the magneto-optic rotation of light.

See also Abstracts 2580, 2591.

GRAVITATION.

See Abstract 2581.

HYDRODYNAMICS AND AERODYNAMICS.

2570. The pressure of water waves upon a fixed obstacle. T. H. HAVELOCK. *Roy. Soc., Proc. A*, **175**, *pp.* 409–421, *July* 18, 1940.—The diffraction of plane water waves by a stationary obstacle with vertical sides is examined, in particular the variation of amplitude along the sides and the average steady pressure due to the wave motion. Results similar to those in other diffraction problems are obtained for an infinite plane and for cylinders of circular or parabolic section, and approximations are made for sections of ship form. The examination was made in view of possible applications in the problem of a ship advancing through a train of waves, and the results are discussed in relation to the average additional resistance in such circumstances. It appears that the mean pressure obtained on diffraction theory from the second-order terms can only account, in general, for a small proportion of the observed effect; the motions of the ship, and in particular its oscillations, are essential factors in the problem.

AUTHOR.

2571. The steady 2-dimensional radial flow of viscous fluid between 2 inclined plane walls. L. ROSENHEAD. *Roy. Soc., Proc. A*, **175**, *pp.* 436–467, *July* 18, 1940.—A general solution is obtained in terms of elliptic functions and the various mathematically possible types of flow are discussed.

AUTHOR.

2572. Three-dimensional vortex motion in a viscous fluid. S. GOLDSTEIN. *Phil. Mag.*, 30, *pp.* 85–102, *Aug.*, 1940.—In order to illustrate the mechanism of the increase of vorticity in turbulent flow due to the extension of the vortex lines, Taylor and Green calculated the development with time, t, of the motion of an infinite incompressible fluid with velocity components, u, v, w, given initially by $u = A \cos ax \sin ay \sin az$, $v = -A \sin ax \cos ay \sin az$, $w = 0$ [Abstract 1037 (1937)]. Their solutions for u, v, w and the pressure, p, are found as power series in t. In order that the effect in turbulent flow of the extension of the vortex lines should be illustrated, the vortex motion considered must be 3-dimensional and possess a definite scale. It appears that a solution in powers of the Reynolds number, R, is preferable to one in powers of t; such a solution of the 3-dimensional problem is derived and is found to contain all the information obtainable from the solution in powers of t and also additional information, more especially for small values of R. J. S. G. T.

2573. Flow through rough circular pipes. T. OKAYA. *Phys. Math. Soc., Japan, Proc.*, **22**, *pp.* 365–377, *May*, 1940.—The analysis relating to the flow of fluid through a smooth circular pipe [Abstract 1715 (1940)] is now extended to the case of rough circular pipes. Roughness is defined in terms of the size of fine sand grains supposed to coat the surface, in accordance with a suggestion made by Nikradse. The mean velocity of

flow through rough tubes is always equal to the velocity at the point whose radial distance, r, from the axis of the pipe of radius a is given by $r = 0{\cdot}775\,a$, independently of the value of Reynolds's number, R, and of the value of the special dimensionless factor Z_1, used by Nikradse. The flow falls into 4 regions described as (1) the laminar region, (2) the transition region, (3) the Blasius region and (4) the turbulent region; mathematical characteristics of the 4 regions are discussed in terms of Nikradse's resistance number. J. S. G. T.

2574. On the turbulent boundary layers at the surface of 2 rotating co-axial cylinders. T. Okaya and M. Hasegawa. *Japanese Journ. Phys.*, **13**, 2, *pp.* 29–49, 1939–1940.—Satisfactory agreement between theoretical deductions and experimental results relating to the flow of fluid between 2 long, hollow, co-axial cylinders, each rotating with uniform angular velocity about their common axis, is obtained by assuming that the velocity components within the boundary layers at the outer surface of the inner cylinder and the inner surface of the outer cylinder obey the 7th root law, and that the turbulent stress components are given by Kármán's expressions. Wendt's experimental results and the work of Prandtl and of Taylor are referred to. It is pointed out that, while in Kármán's work the coefficient of the moment of friction is inversely proportional to the 5th root of the Reynolds number R, the coefficient in the author's work is found to be inversely proportional to $R^{1/6}$. J. S. G. T.

KINETIC THEORY OF MATTER.

2575. Thermal transpiration of a dissociating gas. B. N. Srivastava. *Roy. Soc., Proc. A*, **175**, *pp.* 474–483, *July* 18, 1940.—The thermal transpiration of a dissociating gas is investigated theoretically for 2 chambers maintained at different temperatures and communicating with each other through a narrow opening. It is shown that the condition of thermodynamical equilibrium and the usual transpiration relation for each constituent cannot both be satisfied simultaneously. The problem is treated rigorously from the viewpoint of a steady state. Expressions are worked out showing how the law of mass action suffers modification in this case. Expressions are deduced for the atomic and molecular concentrations in the 2 chambers and the modified transpiration relation is stated. An approximate solution of the problem is given which is based on the assumption of thermodynamical equilibrium in each chamber. Expressions are deduced for the absolute magnitude as well as the ratio of the atomic or molecular concentrations in the 2 chambers in the general case and some limiting cases. Finally, the relative merits and demerits of both the treatments are clearly set forth. Author.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

2576. Operational methods in the theory of airfoils in non-uniform motion. W. R. Sears. *Frank. Inst., J.*, **230**, *pp.* 95–111, *July*, 1940.—Heaviside's operators are employed to obtain the following results: New integral expressions convenient for numerical calculation are obtained for the lift and circulation of a 2-dimensional thin airfoil following a sudden change of its angle of attack or velocity. Approximate expressions are obtained for the initial and final behaviour of these functions. The circulation function is shown to be identical with the function that expresses the lift of an airfoil during and following its entrance into a sharp-edged vertical gust. Author.

2577. Lorentz transformation and Hamilton's quaternions. O. F. Fischer. *Phil. Mag.*, **30,** *pp.* 135–150, *Aug.*, 1940.—A study of the subject with reference to the theory of relativity under the headings of quaternions and quaternation, the " longitudinal " Lorentz transformation, 6-dimensional vectors, the transversal Lorentz transformation, some radius vector properties, and the most general rigid transformation. S. A. S.

2578. Some integral representations of the associated Legendre functions. A. Erdélyi. *Phil. Mag.*, **30,** *pp.* 168–171, *Aug.*, 1940.

1652B. Heaviside operational calculus. H. Jeffreys and D. P. Dalzell.

MECHANICS, CLASSICAL.

2579. Gyroscopic movement of projectiles. R. d'Adhémar. *Ann. Soc. Sci. de Bruxelles*, **59,** *pp.* 18–35, *March* 31, *and pp.* 195–210, *July* 12, 1939.—In continuation of earlier work [Abstract 967 (1939)] the auxiliary solutions by Magnus, Sparre and Burzio, in relation to Mayevski's equation are considered. The validity of the equation is examined and numerical calculations are given. It is shown that Mayevski's function plays a part in certain other gyroscopic movements. Finally, the coefficient of stability or pre-stabilization is examined. R. S. R.

2580. Propagation of motion in viscous media. L. Cagniard. *Ann. de Physique*, **13,** *pp.* 239–265, *May–June*, 1940.—The theory of Duhem and Roy on the equation of the third order governing the propagation of small movements in viscous media is developed. A solution is obtained by the use of the Carson method of integration. The propagation is instantaneous. A. J. M.

2581. An analogy between the theories of potential and vibrations. H. Jeffreys. *Phil. Mag.*, **30,** *pp.* 161–167, *Aug.*, 1940.—The following problem is discussed : let $V(\xi)$ be a given real function for $-\infty < \xi < \infty$; it is required to find a function that will satisfy Laplace's equation in 2 dimensions for $y > 0$, and will reduce to $V(x)$ when $y \to 0$. The significance of the solution in the discussion of problems relating to (1) the variation of gravitational potential over the earth's surface, (2) the vertical temperature gradient in the earth's crust, as measured in boreholes, (3) the sensitivity of recording instruments, e.g. seismographs, is briefly discussed. J. S. G. T.

MECHANICS, QUANTUM.

2582. The variational equation of relativistic dynamics. M. Mathisson. *Cambridge Phil. Soc., Proc.*, **36,** *pp.* 331–350, *July*, 1940.—Mechanics in special relativity are considered. It is proved that the integral of the product of the energy tensor of a closed system into an arbitrary tensor, taken throughout a 4-dimensional region, can be replaced by a line integral along a world line lying in the region. The transformation introduces quantities analogous to the moments of a classical dynamical system. If the system is not entirely contained in the 4-dimensional region, the analysis introduces quantities which play the part of force-components. The equation of conservation is equivalent to the vanishing of the line-integral. This " variational equation " can be solved and the analogues of mass, linear momentum, etc., obtained. G. C. McV.

See also Abstract 2594.

PHILOSOPHY OF SCIENTIFIC METHOD.

2583. Can modern science harmonize physics and biological phenomena? W. F. G. Swann. *Frank. Inst., J.*, **229**, *pp.* 693–708, *June*, 1940.—Consideration is first given to the meaning of the question and to the possibility of defining the sense in which it can have a meaning. A theory which embraces all phenomena is of little value since the more general it is the less it can state about things in particular. An analogy is drawn of a general theory embracing electrodynamics and gravitation which provides a philosophic bridge between astronomical theory and magnetic theory, extrapolation enabling either the one or the other to be neglected in actual problems. Such extremes also occur in the fields of vital phenomena and non-living matter. A fundamental characteristic of the former is the power of reproduction, and an analogous process in the latter is the formation of crystals together with the ionization of a salt in a liquid. The essential idea is that the original entity develops a quantum instability and seeks a new stability in the form of 2 entities. In dealing with the question of determination and free will an example is given of an unpredictable atomic process reflecting itself in a lack of certainty in the prediction of large-scale phenomena. It is pointed out that an individual cannot be held responsible for his acts if it follows logically that owing to the " chance " nature of atomic laws such acts are unpredictable. A. M. T.

RELATIVITY AND ETHER.

See Abstracts 2577, 2582.

SOLUTION.

See Abstracts 2666, 2670, 2688.

SURFACE PROPERTIES.

2584. Theory of the van der Waals adsorption of gases. S. Brunauer, L. S. Deming, W. E. Deming and E. Teller. *Am. Chem. Soc., J.*, **62**, *pp.* 1723-1732, *July*, 1940.—The isotherm equation derived in a previous paper [Abstract 1479 (1938)] for the multimolecular van der Waals adsorption of gases has been extended to cover 2 additional cases : (1) when the heat of adsorption in the first layer is smaller than the heat of liquefaction, (2) when the capillaries of the adsorbent are completely filled, the heat of adsorption in the last layer is greater than the heat of liquefaction. The new equation covers all the 5 types of adsorption isotherms found in the literature. Comparison is made with experimental data and with the capillary condensation theory. Authors.

2585. Benzine synthesis and the activated adsorption of H_2, CO, CO_2 and H_2O by Co and Fe. S. Matsumura, K. Tarama and S. Kodama. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 969, *pp.* 302-322, *May*, 1940. *In German.*—The activated adsorption of H_2 by Co occurs first at 60°C. and attains its maximum at 200°C.; adsorption by Fe begins at 60°C. with a maximum at 160°C. CO is also chemically adsorbed by both Co and Fe and forms carbides, but the temperature for Co is above 60°C. and that for Fe above 190°C. The activated adsorption of CO_2 by Co takes place above 100°C. with a maximum at 150°C., but the absorption by Fe is scarcely apparent at 300°C. The activated adsorption of H_2O by Co has been observed from 30° onwards with a maximum at

100°C., whereas it only occurs for Fe at 200°. The following 3-stage mechanism is proposed for the benzine (petroleum) synthesis: CO first forms a carbide with the catalytic metal, reacting with adsorbed H_2 to produce—CH_2—groups, which are then polymerized, reduced, and thereby converted into hydrocarbons evaporating from the catalyst. These hydrocarbons vary in molecular weight according to the equilibria of the 3 processes. The reason why benzine is produced by Co above 160°C. is that only above this temperature does Co adsorb and activate H_2 appreciably. The higher reaction temperature of Fe is due to the higher temperature necessary for the formation of iron carbide. The cause of H_2O being one of the reaction products formed by Co whereas it is CO_2 in the case of Fe, follows from the fact that the desorption velocity of H_2O is greater for Co. H. H. Ho.

2586. Wettability of highly polished metal surfaces by graphite hydrosols. R. Szymanowitz and B. H. Porter. *Rev. Sci. Instruments*, **11**, *pp.* 230–231, *July*, 1940.—Investigation shows that a straight-line relationship exists between the concentration of aqueous colloidal graphite and the minimum temperature at which it will wet unclean, highly polished surfaces of metal. Surfaces cleaned with metallographic powder and water are wetted by this type of dispersion at room temperature. Authors.

2587. The nature of the sorption surfaces in adsorption and desorption under various conditions. E. Weyde and E. Wicke. *Kolloid Zeits.*, **90**, *pp.* 156–171, *Feb.*, 1940.—The assumption that the speed of adsorption differs from that of desorption is refuted by means of statistical treatment of the results of sorption experiments. The asymmetrical distortion of the desorption surfaces at 0°C. is chiefly explained by the influence on the concentration gradient in the layer of the isothermal curvature. The difference in gradient in adsorption and desorption surfaces that occurs with linear isotherms is ascribed to a hydrodynamic effect. S. G. B.

2588. A surface interaction between ferric and magnesium oxides. H. R. Thirsk and E. J. Whitmore. *Faraday Soc., Trans.*, **36**, *pp.* 862–863, *Aug.*, 1940.—The film formed by evaporation of ferric oxide on to a heated magnesium oxide crystal is found to consist of crystals of a substance of spinel structure apparently $MgO \cdot Fe_2O_3$, which are orientated parallel to the magnesium oxide lattice and which yield diffractions indicating slight twinning on octahedral planes. The patterns show that intense double diffraction occurs. [See Abstract 1428 (1940).] Authors.

2589. The spreading of volatile organic liquids on water in the presence of unimolecular films. E. R. Washburn and C. P. Keim. *Am. Chem. Soc., J.*, **62**, *pp.* 1747–1749, *July*, 1940.—A method has been developed for the measurement of spreading pressures by means of a film pressure balance and a small quantity of the spreading liquid put on a unimolecular film. Spreading pressures of nitrobenzene, toluene, benzene, anisole, diethyl carbonate, and isoamyl chloride on unimolecular films of palmitic acid, stearic acid and tristearin, have been measured by this method. Authors.

See also Abstracts 2549, 2685, 2686, 2692.

TIME.

2590. The time-scale of the universe. H. N. Russell. *Science*, **92**, *pp.* 19–27, *July* 12, 1940.

See also Abstract 2593.

VISCOSITY AND FRICTION.

2591. The structural mechanics of highly elastic continua. The thermodynamics of internal friction. H. Umstätter. *Kolloid Zeits.*, **90**, *pp.* 172–177, *Feb.*, 1940.—The pure temperature function of viscosity is derived without further knowledge of the structure of the continuum by a combination of Maxwell's tension equation with Newton's law of cooling. The viscosity is thus shown to be closely related to the temperature, even in the case of heating at constant volume. This relationship is valid for quite low viscosity values for which empirical formulae have hitherto largely failed. The gradient of the viscosity/temperature function depends to a large extent upon the temperature conductivity of the fluids and is proportional to the critical temperature. S. G. B.

ASTRONOMY AND ASTROPHYSICS.

COMETS AND METEORS.

2592. Probability of occurrence of hyperbolic cometary orbits. M. Taalimi. *Arch. des Sciences*, **22**, *pp.* 32–62, *Jan.–Feb.*, 1940.—The author reviews the evidence for the occurrence of hyperbolic orbits amongst about 1000 comets observed up to 1925. The theory of interstellar origin explains the variety of orbital planes and of indifferent direct or retrograde motions, but the rarity of occurrence of hyperbolic orbits tells against it. The theory of solar origin does not explain how certain cometary orbits can retain their hyperbolic character at great distances from the sun even when planetary perturbations are allowed for; and Charlier's modification of the theory depends on an unverified further hypothesis. The author therefore returns to the interstellar theory. Starting from Laplace's standpoint, the frequency ratio of elliptical to hyperbolic orbits is calculated on the assumption that all velocities are equally probable between zero and certain limiting values. This tacitly assumes that the proper motion of the sun is zero. Taking a possible solar motion into account, the author revises Fabry's method and comes to the same conclusion as Schiaparelli, viz. that the observed rarity of hyperbolic orbits means that there is little relative motion between distant comets and the sun. A. Hu.

COSMOGONY.

2593. Further remarks on the cosmological time scale. F. Zwicky. *Nat. Acad., Sci., Proc.* **26**, *pp.* 332–333, *May*, 1940.—Referring to the conclusion previously reached [Abstract 1748 (1940)] the author points out that the objections raised by Vallarta on the ground of Lemaitre's theory are without substance and that Lemaitre's theory has nothing to do with the time taken by a configuration to reach a statistically stationary state. The discrepancy between the time taken by nebular clusters to reach a stationary state, assuming a law of interaction similar to the Newton law, and the time scale of the expanding universe hypothesis accordingly remains. J. E. K.

2594. Cosmological wave-mechanics. Part. IV. H. JEHLE. *Zeits. f. Astrophysik*, **19**, 3, *pp.* 225–235, 1940.—The author defends his transformation theory of the hydrodynamical equations against a criticism by Rosseland. [See Abstract 663 (1940).] A. HU.

See also Abstract 2618.

NEBULÆ.

2595. Interpretation of spiral structure in the nebulae. B. LINDBLAD. *Astrophys. J.*, **92**, *pp.* 1–26, *July*, 1940.—The succession of types of extragalactic nebulae leading to the final spiral form is interpreted as due to an increase of angular momentum, the latter being related to the mass and mean density of the system. The instability of matter at the edge of a rotating stellar system of great flattening is discussed, the type of disturbance considered being one which gives rise to 2 spiral arms extending from 2 opposite points fixed in space. When fully developed, spiral structure gives rise to a logarithmic shape of the arms in which the particles of the arm describe roughly circular orbits of uniform angular velocity about the centre. A discussion of the properties of the central portion of the nebula leads to the conclusion that this part rotates more rapidly than the spiral structure. Observational results for the Andromeda nebula confirm these views. The question of the orientation of nebulae is discussed, such criteria as the formation of lanes, the relative arrangement of bright and dark matter and the polarization of light in the dark clouds, being considered. It is concluded that observation supports the view that the rotation is in the direction in which the spiral arms wind when followed outward from the centre. G. C. McV.

See also Abstract 2593.

STARS.

2596. The absolute magnitudes of stars of high luminosity. J. L. GREENSTEIN. *Nat. Acad. Sci., Proc.*, **26**, *pp.* 259–264, *April*, 1940.—The distances of stars of high luminosity are determined by extrapolation of known distances, based on the theory of galactic rotation using radial velocity as a measure of distance, and the mean absolute magnitudes are thence derived assuming the same mean coefficient of interstellar absorption as for B stars. Mean absolute magnitudes ranging from $-6{\cdot}3$ for cB and cA stars to $-4{\cdot}6$ for BO stars and $-3{\cdot}3$ for B2 stars are obtained; the high value for early supergiants is of importance to problems of interstellar reddening. The use of distances based on galactic rotation gives a smaller reddening coefficient than is otherwise obtained. A preliminary calibration of later type C-stars is given. J. E. K.

2597. The spectrum of ν Sagittarii. J. L. GREENSTEIN. *Astrophys. J.*, **91**, *pp.* 438–472, *May*, 1940.—Wavelengths and intensities of 400 lines between λ3 317 and 3 975 Å in the spectrum of ν Sagittarii are measured. H lines are weak and He lines strong as well as those of single ionized metals. A list of identified elements is given. The most striking difference between the spectra of the supergiants ν Sgr and α Cyg is the extreme weakness of the H lines in the former and the disappearance of the jump in intensity at the Balmer limit. A model atmosphere with $T = 10\,000°$ and an electron pressure of about 100 bars gives intensities similar to the observations. It is deduced that the abundances of He and Fe are, respectively, 10^2 and 10^{-2} times that of H. The presence of lines

of other elements of very high excitation potential, notably AII, apparently indicates a higher excitation temperature for the extreme ultra-violet. H contributes less than He to the continuous absorption coefficient.

J. E. K.

2598. Double reversal of H and K lines in spectrum of α Boötis. P. WELLMANN. *Zeits. f. Astrophysik*, **19**, 3, *pp.* 236–248, 1940.—The contours of the lines H and K are measured in well exposed spectrograms of α Boötis. The strong double reversal shown is interpreted as due to an elevated, thermally emitting, chromospheric layer. Comparison of the observed with the theoretical intensity distribution suggests for this layer an optical thickness of about 10^{-3}, a turbulence velocity (Doppler breadth) of 8 km./sec., and a temperature of 1 000° or 1 500° above the undisturbed value. The resulting temperature inversion in the outer atmosphere is compared with the similar phenomenon suspected in ζ Aurigae and established in the facular regions of the sun. A. Hu.

2599. Physical characteristics of Wolf-Rayet stars and their relation to other objects of early type. C. S. BEALS. *Roy. Astron. Soc. Canada, J.*, **34**, *pp.* 169–197, *May–June*, 1940.—The Wolf-Rayet spectra are described and the emission interpreted as due to the continuous ejection of high-speed atoms from the stellar surface. The mechanism of the emission is explained by a process of ionization and recombination, and the resulting iono-stratification in the atmosphere is discussed. The temperatures, absolute magnitudes and diameters, of the carbon and nitrogen types are estimated and the close relation between Wolf-Rayet stars, P Cygni stars and the supergiants of class A, is pointed out and illustrated by reproduced spectra. Evidence is given that these objects comprise a definite spectral sequence following a different course from the main sequence and separated from it by some physical characteristic as yet imperfectly understood. An analogy is drawn with the successive stages of typical nova spectra; and this gives rise to a discussion of the origin and evolution of these stars. A. Hu.

2600. Nature and evolution of Algol-type systems. K. WALTER. *Zeits. f. Astrophysik*, **19**, 3, *pp.* 157–224, 1940.—A working hypothesis is advanced by which relations, depending closely on the shape of the orbit, are derived between the parameters determining the physical constitution of the components of close binary systems. The hypothesis is applied to deriving the relative and approximate absolute dimensions of 83 binary systems comprising sub-giant components. Two groups of such systems are distinguished, differing by the physical nature of the principal components (α- and β-states of A stars). It is possible for the sub-giant components, and under certain circumstances the primary components also, to undergo sudden expansion during periodic changes of shape. The interpretation of the observations leads to confirmation of the hypothesis that the early-type main-sequence stars possess a marked tendency to exhibit internal differences of rotation. This property may be the main reason for the frequent occurrence of close binaries with early-type primaries and extended secondaries of small mass. A. Hu.

2601. Synthetic spectra for supernovae. C. PAYNE-GAPOSCHKIN AND F. L. WHIPPLE. *Nat. Acad. Sci., Proc.*, **26**, *pp.* 264–272, *April*, 1940.—From a study of Minkowski's spectra of supernovae, assumed analogies between novae and supernovae and other considerations, broad conclusions are drawn as to the conditions determining the spectral appearance

of supernovae, namely a comparatively low temperature, $\simeq$ 10 000–30 000°K., broad-line emission and absorption corresponding to a Doppler velocity of about 6 000 km./sec., a low H and high He abundance. On the basis of these conditions an attempt is made to synthesize the supernova spectra from summation of 19 bright-line spectra of the 8 astrophysically commonest elements together with a temperature continuum. Spectra similar in most general features to those observed by Minkowski are obtained in this way and explanations of these features are given; the progressive shift with time towards the red shown by the blue parts of the spectra is shown to be explicable in terms of the change in atomic make-up of the spectra due to increase of excitation with time. A tentative physical picture of a supernova outburst is derived. J. E. K.

2302. The work of the Mt. Wilson Observatory. W. S. Adams and F. H. Seares. *Roy. Astron. Soc. Canada, J.*, **34,** *pp.* 198–205, *May–June,* 1940.—This general review of the work of the Mt. Wilson Observatory is taken from the Carnegie Institution of Washington Year Book No. 38, for the year 1938–1939.

See also Abstract 2594.

GEOPHYSICS.

GEODESY.

2603. Results of re-running the line of levels linking Sibata with Taira. N. Miyabe. *Imp. Acad. Tokyo, Proc.*, **16,** *pp.* 178–181, *May,* 1940.—The vertical displacements of bench marks were computed with reference to one at Sibata which had an assumed vertical displacement of $-24{\cdot}1$ mm. for the period 1897–98 to 1939. The results are tabulated. It was found that the land as a whole tilted eastwards approximately $0{\cdot}2''$ in the direction of the general trend. The earth's surface in the mountain ranges appears to have upwarped slightly. Near Taira there was a marked subsidence and in the last 5 years it amounts to $-168{\cdot}0$ mm. at 3 points. R. S. R.

2604. Results of re-running the line of levels crossing Mt. Asama. N. Miyabe. *Imp. Acad. Tokyo, Proc.*, **16,** *pp.* 182–183, *May,* 1940.—25 bench marks were laid down in 1935 on a line across Mt. Asama and, with a pre-existing line of levels, a complete circuit is formed. The levels were checked again in 1939. Several volcanic eruptions occurred in this period. The western slope of Asama had upwarped with a maximum elevation of about 40 mm. while a slight subsidence occurred in another area. R. S. R.

GEOPHYSICS, APPLIED.

2605. Seismic investigations on the Palaeozoic floor of E. England. E. C. Bullard, T. F. Gaskell, W. B. Harland and C. Kerr-Grant. *Roy. Soc., Phil. Trans. A*, **239,** *pp.* 29–94, *July* 4, 1940.—The depth of the Palaeozoic floor under part of E. England has been investigated by the refraction seismic method. Records have been taken every 200 ft. along lines 4 000–8 000 ft. long; such detailed shooting enables various sources of uncertainty in the results to be investigated. The interpretation of the

seismic results required a more thorough knowledge of the contours of the Jurassic and Cretaceous than was available; the data from bore-holes and outcrops have therefore been collected and are presented in the form of contoured maps showing the depths of various horizons and the thicknesses of rock between them. A map of the form of the Palaeozoic floor and a discussion of its constitution are also given. The latter is based on a re-examination of the bore-hole cores and on the seismic velocities.

AUTHORS.

See also Abstract 2609.

HYDROSPHERE, PHYSICS OF THE.

2606. Floods in the Sacramento Valley, February 27–March 6, 1940. E. H. FLETCHER. *Monthly Weather Rev.*, **68**, *pp.* 71–74, *March*, 1940.

See also Abstract 2616.

LAND, PHYSICS OF THE.

2607. Loss of heat by conduction from the earth's crust in Britain. W. M. ANDERSON. *Roy. Soc. Edinburgh, Proc.*, **60**, 2, *pp.* 192–209, 1939–1940.—The flow of heat as deduced from observations at the Boreland Bore near Dysart, Fife, 3 303 ft. deep, after allowing for the results of the glacial epoch, nature of beds passed through, etc., is $1{\cdot}28 \times 10^{-6}$ cal./cm^2. sec. This is compared with the flow as deduced from other bores in England and Scotland. All the observations give an average of $(1{\cdot}500 \pm 0{\cdot}083) \times 10^{-6}$ cal./cm^2. sec. The methods adopted in the calculations and arguments in support thereof are described in detail. C. A. S.

2608. Interatomic forces and helium in rocks. N. B. KEEVIL. *Am. Acad., Proc.*, **73**, *pp.* 311–359, *June*, 1940.—Data concerning the size of the He atom and potential energy curves involving He show its size to be large compared with the structural holes in common minerals. The chance of a He atom, when formed, escaping through distortion channels resulting from radioactive decay would be high in radioactive minerals but as a rule small in ordinary rock minerals. Calculation shows that an opening at least 1·2 Å wide would be necessary. Calculations based on an activation energy treatment show that no diffusion can occur when the interatomic distances (He–O) are less than 1·9 Å, which would imply that diffusion would occur through beryl and valentinite, but not through common rock minerals—though no diffusion through beryl could be detected. A detailed discussion of all relevant facts and investigations leads to the conclusion that ages deduced from carefully selected minerals should not differ from true values by more than the present experimental errors of measurement. C. A. S.

2609. Electrodynamic hydrology. H. LÖWY. *Terr. Mag.*, **45**, *pp.* 149–154, *June*, 1940.—Two fundamental equations of electrodynamic hydrology are stated and applied to (1) the electric measurement of water content and thence the film thickness, (2) the change in relationship between soils and their moisture content and its effect on plant life, (3) the dielectric constant of the soil as an indication of structure at great depths, (4) the dielectric constant of rock substances as a means of identifying rocks, (5) the use of the electric method to measure compressibility and consolidation of soil without disturbing it, (6) the infiltration of rain, (7) the presence of mineral conducting ores and (8) the measurement of small quantities of water content during chemical reactions. R. S. R.

2610. Physical properties of the lavas of volcanos Asama and Mihara. Magnetic susceptibility. T. NAGATA. *Tokyo Univ. Earthquake Research Inst., Bull.*, **18,** *pp.* 102–134, *March,* 1940.—A modified form of the Stschodro ballistic instrument was used ; 10 samples of rock from Asama and 6 from Mihara were tested. It was found that (1) the susceptibility of the rocks is nearly proportional to the amount of magnetite in them, (2) the degree of susceptibility may depend on the chemical composition of the rocks as well as on the size of the ferromagnetic minerals, (3) the susceptibility increases as the external magnetic field increases, the rate of increase depending on the chemical composition and the shape of the ferromagnetic microlites, and (4) the intensity of the remanent magnetization is closely related to the rate of change of susceptibility in various magnetic fields. R. S. R.

2611. Laws of capillary action of soil. K. SCHULTZE. *Kolloid Zeits.*, **90,** *pp.* 268–294, *March,* 1940.—A discussion of the various phenomena, such as meniscus, curvature reversal, speed of ascent, etc., involved in wetting of soils.

2612. Some aspects of the physics of water-table rise and salt movement in the soil under irrigated conditions. E. M. TAYLOR. *Indian Acad. Sci., Proc. A,* **11,** *pp.* 451–466, *May,* 1940.—The importance of the presence of a zone of field capacity moisture content on the movement of moisture in a soil has been investigated in the laboratory. Observations have been recorded which show that under irrigated soil conditions in the Punjab there is a permanent field capacity moisture zone situated below a depth of 6 ft. from the natural surface. The presence of the field capacity zone has been shown to prevent water rising from a water table as a result of evaporation at the soil surface. It follows that evaporation cannot be a factor controlling water table level when the water table is at a greater depth than 10 ft. If the water table is situated within 10 ft. of the surface then some control may be established by evaporation if the pellicular stage zone is completely developed. This condition rarely occurs under irrigation. It has been shown that there is no essential connection between the rise of water table and the rise of salts in the soil. The application of the movement of moisture in a soil to the processes of land deterioration, reclamation and its permanency, have been discussed. AUTHOR.

See also Abstract 2581.

METEOROLOGY.

2613. The formation of depressions of the Khamsin type. M. G. ELFANDY. *Roy. Meteorolog. Soc., J.*, **66,** *pp.* 323–335, *July,* 1940.—A further study has been made of the conditions in spring which produce khamsin conditions in Egypt. Depressions are then formed which travel from W. to E. to the S. of, and roughly parallel to, the N. African coast ; and, as a rule, while the more vigorous depressions usually originate far to the W. of Egypt, shallow depressions form in Egypt or slightly to the W. of it. Such depressions are regarded as produced in the manner suggested by Margules—unstable conditions prevailing between intensely heated air to the S. and cool air to the N., the moisture of the air playing a non-essential part. The cold air is due to an anticyclonic distribution in the Mediterranean, while the hot air is drawn northward from the Sudanese low when it suffers large oscillations towards the N. These

oscillations are in the main brought about by the travelling depressions, the current bringing the hot air being specially strong when the depressions reach the Red Sea. AUTHOR.

2614. Historical note on the standard for the measurement of atmospheric pressure in India. J. M. SIL. *India Meterolog. Dept., Sci. Notes*, **8**, 88, *pp.* 47–65, 1940.—The data of atmospheric pressure in India have been based for about 75 years on the Calcutta standard. The relation of this Indian standard to the Kew standard barometer has been traced for the period 1871 to date; the mean value of its correction with respect to the Kew is found to be −0·009 in. An account of the Calcutta standard together with the procedure adopted for its maintenance is given. The importance of this Indian standard, which has been the basis for all pressure data collected from the whole of the Indian land and sea areas and also from the adjoining countries of Burma, Afghanistan, Iran and Arabia, is emphasized. The history of the substandard barometers maintained in the India Meteorological Department has also been collected as far as possible and given in the Appendix. AUTHOR.

2615. A new approach to the study of the seasonal incidence of British rainfall. P. R. CROWE. *Roy. Meterolog. Soc., J.*, **66**, *pp.* 285–311; *Disc.*, 311–316, *July*, 1940.—The rainfall records for the period 1881–1930 of 70 British stations are analysed by a method of direct comparison of monthly values which does not involve the calculation of means. The tendency towards a regular annual régime of rainfall being rather weak over most of these islands, the object is to try and single out significant facts from the mass of detail which is purely fortuitous in character. The results are expressed in maps and tables. Taking the country as a whole the periods of most rapid change in precipitation conditions are shown to have been from June to August and from December to February. There is, however, a considerable amount of regional contrast, particularly in the comparison of August with October values, whilst the distribution of anomalous conditions in September is also of interest. The analysis is then carried back to the period 1831–1880 for 12 stations. The general verdict seems to be that rapid rainfall transitions during that period fell between April and June, October and December. The rainy period was thus the same length as in the later half century but occurred earlier in the year. At the same time the September anomaly disappeared. If the test of significance employed is not seriously at fault—and it would seem to err if anything on the side of severity—we must face the conclusion that the hypothesis of an ultimate normal of rainfall may have to be reconsidered. AUTHOR.

2616. Windermere Basin: rainfall, run-off and storage. W. N. MCCLEAN. *Roy. Meteorolog. Soc., J.*, **66**, *pp.* 337–356; *Disc.*, 357–362, *July*, 1940.—The characteristic details of the catchment area, rainfall stations, flow-gauging and water level stations, are given. The British Rainfall Organization and river flow records for assessment of the area rainfall are explained and the isopercental method applied for the flood period July 20th to August 13th, 1938. For the run-off a stage discharge table has been built up from various data and its accuracy is tested in 3 examples. A further table is obtained for the drop in discharge during a period of dry weather. This provides a standard basis for the determination of the residue of aggregate run-off at any time during dry weather for average conditions of saturation and evaporation. The records are analysed to obtain (1) seasonal relationships of rainfall and loss.

(2) rainfall run-off and loss during 5 short periods each ending with dry days, and (3) a detailed analysis of the flood period July 20th to August 13th, 1938. Comments are made on general rainfall and records. R. S. R.

***2617. New form of condensation hygrometer.** T. Okada and M. Tamura. *Imp. Acad. Tokyo, Proc.*, **16,** *pp.* 141–143, *April,* 1940.—The instrument is devised to overcome difficulties inherent in the usual dew-point apparatus. The principle of the instrument leads to the expression $f = F' + \Delta p - \lambda \cdot (R/v)\Delta T$, where f is the vapour tension to be measured, F' the saturation pressure at the dew point, Δp the decrease of total pressure of the air when cooled to the dew point, λ and v the mass and volume of the air and ΔT the cooling required to produce saturation. All these terms are measured directly in a few minutes with the apparatus described. Sources of error are mentioned. R. S. R.

2618. An astronomical hypothesis to explain Permian glaciation. R. L. Ives. *Frank. Inst., J.*, **230,** *pp.* 45–74, *July,* 1940.—Speculation concerning possible causes of Permian circumequatorial glaciation has resulted in several interesting hypotheses, among which are those postulating various continental drifts, and several based on assumed changes in atmospheric circulation occurring as a result of relatively minor changes in the size, relative location or interconnection, of the continental masses. An astronomical hypothesis, attributing the known climatic peculiarities of the early Permian to the effects of a ring of small satellites about the earth in approximately the plane of the equator, is here presented. This, for convenience, will be referred to as the ring hypothesis. Author.

2619. Climates of the past. P. G. H. Boswell. *Roy. Meteorolog. Soc., J.*, **66,** *pp.* 249–274, *July,* 1940.—The author reviews the geological evidence for climatic changes in past epochs, under the following heads: lithology, including the size, shape and mineral composition, of the constituent particles and the character of the cementing materials; stratigraphology, including study of form, structure and wind-fluted and ice-striated surfaces; study of the contained fossils, animal and plant. No evidence is found of conditions that cannot be interpreted in the light of present knowledge. Conversely, geology can furnish proof of the past existence of most of the climatic types of to-day. A. Hu.

2620. Report on the phenological observations in the British Isles from December, 1938, to November, 1939. H. C. Gunton. *Roy. Meteorolog. Soc., J.*, **66,** *pp.* 281–282; *Disc.*, 282–284, *July,* 1940.

2621. How are mock suns produced? F. J. W. Whipple. *Roy. Meteorolog. Soc., J.*, **66,** *pp.* 275–279, *July,* 1940.—The discussion arises out of a photograph of a mock sun taken near Aldershot on May 14, 1940, when the sun was 4° above the horizon. Early attempts at the explanation of the 22° halo and the mock suns which occasionally accompany it are mentioned, in particular the fact that Newton from his observation of the radius of the halo deduced that the refracting angle of the crystals producing it was 58° or 60°. After outlining the optics of the phenomena and showing that, to produce mock suns, hexagonal ice crystals must be falling in the air with their axes vertical, the author discusses the difficulty in explaining how these crystals can fall with their axes vertical. Various suggestions are examined. A. E. M. G.

***2622. A Dutch radio-meteorograph.** C. M. A. Insje and J. L. van Soest. *Roy. Meteorolog. Soc., J.*, **66,** *pp.* 317–322 *with Disc., July,* 1940.—This paper contains an account of the radio-meteorograph which has been developed in Holland in order to secure accuracy, lightness and cheapness.

Following Moltchanov's principles it sends out letters in the Morse code which can be received on an ordinary short-wave receiving set. One valve is employed. The signaller is driven by a small electric motor and the set is operated by either one or two $4\frac{1}{2}$ V flashlight batteries according to the height to be reached. The total weight with 2 batteries is 585 gm. Experience shows that a very large proportion of the radio-meteorographs are recovered in good condition, fit for further use. AUTHORS.

See also Abstract 2606, and
1754B. Upper-air weather soundings by radio. H. Diamond, W. S. Hinman, Jr., F. W. Dunmore and E. G. Lapham.

SEISMOLOGY.

2623. Microseisms caused by transmission of atmospheric disturbances. K. SEZAWA AND K. KANAI. *Tokyo Univ. Earthquake Research Inst., Bull.*, **17**, *pp.* 548–557, *Sept.*, 1939.—The condition for an atmospheric disturbance being transmitted through a layer in the form of compressional waves is that the velocity of the current is less in the layer than outside. The wavelength for which the amplitude of the 2 kinds of waves is a maximum is found mathematically. Two kinds of waves are transmitted, one with a velocity near to that of sound and the other with a velocity much less. These waves are transmitted with or against the wind, depending on the wind velocities in the upper and lower atmosphere.

R. S. R.

See also Abstract 2581.

RADIOACTIVITY.

2624. Sargent curves. S. KOJIMA. *Phys. Math. Soc. Japan, Proc.*, **22**, *pp.* 384–390, *May* 1940.—Sargent curves are plotted for isotopes of atomic numbers between 29 and 33, using results previously obtained by the author. The curves fit Fermi's theory better than the K-U theory. The same result is obtained both for very light elements ($Z < 18$) and for natural radioactive elements. If the points for Sargent curves are plotted for all elements, both positron and electron emitters, using observed upper limits, a bounding line is obtained on the high-λ side. E. E. W.

2625. Radioactive isotopes of Sr, Y and Zr. L. A. DUBRIDGE AND J. MARSHALL. *Phys. Rev.*, **58**, *pp.* 7–11, *July* 1, 1940.—Radioactive isotopes formed by bombardment of Rb, Sr and Y by protons, deuterons and neutrons are reported. The following are the periods and assignments: 2·75 hr. (Sr^{87*}, e^-, γ); 70 min. (Sr^{85}, e^-, γ); 66 day (Sr^{85}, K, γ); 80 hr. (Y^{87}, K); 14 hr. (Y^{87}, e^-, γ); 105 day (Y^{86}, K, γ); 4·5 min. (Zr^{89}, γ); 78 hr. (Zr^{89}, β^+). (In each case e^- means conversion electrons, not nuclear β-rays.) The electron spectrum of the 2·75 hr. Sr^{87*} shows a single line at 360 ekV and this period is shown to grow from the 80 hr. Y^{87}, but not from the 14 hr. isomer. AUTHORS.

2626. Radioactive products from gases produced in uranium fission. G. N. Glasoe and J. Steigman. *Phys. Rev.*, **58**, *pp.* 1–6, *July* 1, 1940.—The chemical identity and characteristic half-life periods of some radioactive products from the gases produced in the fission of U by slow neutrons have been studied. Two Rb activities have been observed, one of which decays with a period of $15{\cdot}4 \pm 0{\cdot}2$ min. into an active Sr with a half-life of 51 ± 2 days; the other decays with a period of $17{\cdot}8 \pm 0{\cdot}2$ min. into an apparently inactive end product. The parent of the 15·4 min. Rb is a gas with a half-life of a few min. whereas the other Rb arises from the decay of a 175 ± 10 min. Kr. Absorption in Al indicates the maximum β-particle energy for these active products to be 3·8 eMV for the 15·4 min. Rb and 4·6 eMV for the 17·8 min. Rb. In a similar manner, a Cs has been observed which decays with a $32 \pm 0{\cdot}5$ min. period into a Ba which is inactive or of very long or short period with no evidence of the 300 hr. product reported by Hahn and Strassmann. Data have been obtained which indicate that this long-period Ba arises from the decay of a product of a very short-period gas. This 32 min. Cs results from the decay of a Xe with a half-life of 17 ± 1 min. Absorption in Al indicates a maximum β-particle energy of 2·6 eMV for this Cs activity. Authors.

2627. Formation of He from α-ray emission. P. L. Günther. *Zeits. f. phys. Chem. A*, **185**, 5, *pp.* 367–374, 1939.—The quantity of He formed from U is determined and from it the disintegration constant of U·I is calculated as $1{\cdot}74 \times 10^{-10} \times a^{-1}$. This figure is 10·8% larger than the value accepted at present. In explanation of this discrepancy it is assumed that the U-salt contains α-ray emitting substances as impurity. Similarly, the He formed from Ra was measured. The disintegration constant for Re calculated from the measurements was $4{\cdot}35 \times 10^{-4} \times a^{-1}$. The number of α-particles emitted from 1 gm. of Ra per sec. is given as $3{\cdot}67 \times 10^{10}$. These figures are in close agreement with those obtained by the latest physical methods. S. G. B.

See also Abstracts 2703, 2704.

RADIATION.

COLORIMETRY.

***2628. Production colour analysis of cinescope screens.** T. B. Perkins. *J.O.S.A.*, **30**, *pp.* 295–296, *July*, 1940.—An apparatus for analysing the "degree of whiteness" of cinescope screens in production is described. A 3-colour process of producing a matching colour for any acceptable cinescope is discussed and design given. Author.

EMISSION.

***2629. An automatic apparatus for measurement of emanation.** K. E. Zimens. *Zeits. f. phys. Chem. A*, **186**, 2, *pp.* 94–105, 1940.—A description of an apparatus is given which enables measurement of emanation/temperature relationships to be made direct and recorded photographically and automatically. The procedure is exemplified by curves obtained for

various mixed crystals. The advantages are : (*a*) Measurement is continuous so that every detail is recorded, even where changes in emanation phenomena are rapid ; (*b*) since the temperature/time curve is recorded simultaneously, the effects of an irregular rise in temperature on the emanation curve, which are considerable, become evident ; (*c*) personal errors are eliminated ; (*d*) by using 2 furnaces alternately an uninterrupted record can be obtained. S. G. B.

See also Abstract 2635.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTER-GLOW.

2630. Optimum efficiency conditions for white luminescent screens in cinescopes. H. W. Leverenz. *J.O.S.A.*, **30,** *pp.* 309–315, *July,* 1940.—Calculations based on energy ratios and relative luminosities of complementary colours show that the efficiency of white-light production is greatest for the pair of spectral lines at 4 590 Å (violet blue) and 5 720 Å (yellow green). Spectral distribution curves of relative absorption and emission are given for the Zn-Cd sulphide P-systems and for typical white cinescope screens. Author.

INTERFERENCE, DIFFRACTION AND SCATTERING.

***2631. A vacuum interferometer for precise measurements.** R. M. Elliott. *Rev. Sci. Instruments,* **11,** *pp.* 235–236, *July,* 1940.—The serious effect of pressure and temperature variations in the use of a Fabry-Perot interferometer is outlined together with a method successfully employed to reduce these variations to a reasonable limit. Author.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

***2632. A contrast meter for photographic papers.** C. A. Morrison. *Kodak Research Lab., Comm. No.* 759. *J.O.S.A.*, **30,** *pp.* 299-301, *July,* 1940.

See also Abstracts 2717, 2718.

PHOTOMETRY.

2633. Theory of the crossed-slit method of observation. H. Svensson. *Kolloid Zeits.*, **90,** *pp.* 141–156, *Feb.*, 1940.—The accuracy with which the concentration can be determined is calculated for 2 different methods of illumination and its relative value shown. The systematic errors caused by deflection of the light rays in the cell, or arising in the cell itself when convergent light is used, is calculated and the errors are illustrated by examples. Details of the lenses are given and the correction discussed. S. G. B.

POLARIZATION.

***2634. Vectographs : images in terms of vectorial inequality and their application in 3-dimensional representation.** E. H. Land. *J.O.S.A.*, **30,** *pp.* 230–238, *June,* 1940.—The light emerging from a sheet of polarizing material is regarded as a vectorial field in which the vector is the electric vector of the polarized portion of the emergent beam. The paper discusses the properties of a " controlledly non-uniform " vectorial field created with or in polarizing surfaces, and a vectograph is an image rendered in terms of vectorial inequality. A brief introductory survey of the geometry

of the vectograph is given with the aid of 4 different types. Thereafter the paper describes the preparation of a vectograph and the effect of superposing vectographs with some of the uses of the latter in engineering, astronomy and other fields. In 3-dimensional representation the left- and right-eye images are rendered as 2 vectographs with the axis of polarization of one crossed with the axis of the other. The observer wears viewers in which the analysers have their axes set in correspondence with the images. The method is capable of stereoscopic projection, prints for direct viewing and 3-dimensional vectographs in natural colour. G. E. A.

2635. Note on the polarization of light emitted by electrically exploded wires. W. M. Cohn. *Phys. Rev.*, **58**, *pp.* 50–51, *July* 1, 1940.—It is concluded that scattered and reflected light do not contribute to the emission from electrically exploded wires. This leaves temperature radiation and continuous electron radiation as the only factors causing the emission of the continuous spectrum. Author.

See also Abstract 2539.

REFLECTION, REFRACTION AND DISPERSION.

2636. Normal systems with two caustic lines. M. Herzberger. *Kodak Research Lab., Comm. No.* 734, *Suppl. J.O.S.A.*, **30**, *pp.* 307–308, *July*, 1940.—Supplement to Abstract 4571 (1939).

***2637. Exact and approximate computation of Schmidt cameras. Part I. The classical arrangement.** F. A. Lucy. *J.O.S.A.*, **30**, *pp.* 251–254, *June*, 1940.—An exact equation is derived for the surface of the correcting plate of a Schmidt camera when placed at the centre of curvature of the spherical mirror. An approximate formula is also derived which is, however, rather more precise than formulae previously available. The performance of actual instruments made according to the old and new equations will differ significantly if the surfaces are figured with exceptional care. W. D. W.

2638. Analysis of the double refraction curve. A. Frey-Wyssling. *Kolloid Zeits.*, **90**, *pp.* 33–40, *Jan.*, 1940.—The double refraction curves in Weiner's mixed-body theory are hyperbolae. Usually these have an axis of symmetry parallel to one of the co-ordinates. The present paper records a discussion on the departure of the axis of symmetry from this position and the bending of the arms of the hyperbola. S. G. B.

2639. The refractivity of formamide. G. F. Smith. *Chem. Soc., J.*, *pp.* 869–870, *July*, 1940.—Measurements have been made of the refractive indices of formamide at 20° for 20 wavelengths in the visible spectrum. The refractive dispersion can be represented by a simplified Ketteler-Helmholtz dispersion formula containing 1 variable term, but it is unlikely that this equation will apply unchanged to other regions of the spectrum. Author.

SPECTROSCOPY.

2640. Evidence for a nuclear electric quadrupole moment for Sb^{123}. D. H. Tomboulian and R. F. Bacher. *Phys. Rev.*, **58**, *pp.* 52–54, *July* 1, 1940.—Measurements of the hyperfine structure of the line $\lambda 5\,895$ of Sb II by the use of a Fabry-Perot interferometer have shown that there are deviations from the interval rule in the case of the isotope with mass number 123. The hyperfine structure intervals of the $^3D_1$ level of Sb^{121} ($I = 5/2$) are found to be $0{\cdot}680\,1$ and $0{\cdot}483\,2\ cm^{-1}$. The corresponding

intervals in Sb^{123} ($I = 7/2$) are 0·481 4 and 0·360 3 cm^{-1}. The error in these measurements is of the order of 0·001 cm. The observed ratio of the 2 separations gives 1·407 and 1·336 for the light and heavy isotope, respectively, whereas the corresponding ratios on the basis of the interval rule are 1·400 and 1·286. The deviation in the case of the light isotope is within the experimental error. The deviation for the heavy isotope, however, is a real effect which cannot be accounted for on the basis of perturbing effects of neighbouring levels and must therefore be ascribed to the presence of an electric quadrupole moment of the nucleus of Sb^{123}.

AUTHORS.

2641. Description and analysis of the second spectrum of vanadium (V II). W. F. MEGGERS AND C. E. MOORE. *Bureau of Standards, J. of Research,* **25,** *pp.* 83–132, *July,* 1940.—Wavelength measurements and intensity estimates are presented for 1 700 V II lines with wavelengths ranging from 7 015·49 Å in the red to 1 313·82 Å in the extreme ultra-violet. The main criterion for selecting these lines was enhancement in the spark as compared with the arc. Supplementary data on furnace-temperature classes and Zeeman patterns for many of these lines support their characterization of singly ionized V atoms. Analysis of all the available data resulted in the identification of 89 spectral terms, combinations of which account for 1 456, or 86%, of the observed lines. The identified terms include 31 singlets, 41 triplets, and 17 quintets. This is the first spectrum in which all theoretical terms arising from electron configurations d^3s and d^4 have been established (except the highest singlet in each set). The lowest energy state of V^+ ions is represented by $(3d^4)a\ ^5D_0$, but the strongest emission lines involve $(3d^3\ 4s)a\ ^5F$, a metastable term. Without doubt, the most intense line of the V II spectrum is $(3d^3\ 4s)a\ ^5F_5 - (3d^3\ 4p)z\ ^5G_6$, with wavelength of 3 093·108 Å, arising from a simple s–p transition. A great majority of the observed lines are explained as combinations of low (even) terms with middle (odd) terms resulting from the configurations $3d^3\ 4p$ and $3d^2\ 4s4p$. The first high (even) terms probably originate with $3d^3\ 4d$ and $3d^3\ 5s$, but only fragments of the former and none of the latter could be found. Line intensities in multiplets, level separations in complex terms and magnetic splitting factors (g-values), indicate that LS coupling predominates among the 4 electrons involved in the production of the V II spectrum. With few exceptions the polyfold terms are regular, and many obey the Landé interval rule rather well. Zeeman-effect observations for 380 lines disclose the g-values for 143 atomic-energy levels. A comparison of observed and Landé g-sums for levels given by the $d^3\ 4s$ configuration shows satisfactory compliance with the g-sum rule if the scale of the observations is increased 2 to 3%. Guided by theoretical expectations and analogies with similar spectra, the electronic configurations responsible for the observed terms have been identified in nearly all cases. Inability to establish any levels belonging to the $d^3\ 5s$ configuration, in series with $d^3\ 4s$, postpones a spectroscopic determination of the ionization potential of V^+ ions until this spectrum has been studied under conditions which favour the emission of spectral series. For the present, the only value of this constant is an estimate of 14·1 V by Russell. AUTHORS.

2642. The infra-red spectrum of methyl mercaptan. H. W. THOMPSON AND N. P. SKERRETT. *Faraday Soc., Trans.,* **36,** *pp.* 812–817, *Aug.,* 1940.—The infra-red absorption spectrum of methyl mercaptan vapour has been studied between 1–16μ. The wavelengths of the bands observed have been correlated with the known Raman frequencies. A satisfactory

assignment of the different magnitudes to the normal modes has been achieved, with 1 exception. The missing frequency is that corresponding to the internal torsional motion about the C-S bond. The band contours are compatible with the molecular structure assumed. The normal frequencies have been compared with those of related molecules. AUTHORS.

2643. The infra-red and Raman spectra of ethylene sulphide. H. W. THOMPSON AND D. J. DUPRÉ. *Faraday Soc., Trans.*, **36,** *pp.* 805–812, *Aug.*, 1940.—The infra-red absorption spectrum of ethylene sulphide has been measured between 1–17μ. The Raman spectrum has also been measured. The 2 sets of data have been applied to the assignment of magnitudes to the normal modes of vibration, and a plausible assignment of 14 out of 15 vibrations is made. The envelopes of some of the infra-red bands are discussed. Some observations on the ultra-violet spectrum are recorded. AUTHORS.

2644. The infra-red spectrum of dimethyl Zn. H. W. THOMPSON, J. W. LINNETT AND F. J. WAGSTAFFE. *Faraday Soc., Trans.*, **36,** *pp.* 797–805, *Aug.*, 1940.—The infra-red spectrum of dimethyl Zn has been studied between 1–17μ, and the data are correlated with known Raman data. Assignment of the various frequencies to normal modes is examined for different possible classes of molecular symmetry. Some ambiguity remains, but the facts suggest that the molecule has the linear structure D_{3h}, but may be flexible. In the normal state there appears to be a torsional oscillation indicating restricted internal rotation, but the potential barrier between this state and that of free rotation may be small. AUTHORS.

2645. Spectroscopic evidence for hydrogen bonds: effects of chelation on the carbonyl frequency. W. GORDY. *J. Chem. Phys.*, **8,** *pp.* 516–519, *July*, 1940.—The vibrational band characteristic of the carbonyl linkage was measured for *o*-hydroxyacetophenone, *o*-methylaminobenzoate, *o*-methylsalicylate, *o*-hydroxybenzaldehyde and for compounds similar to these but lacking an adjacent proton-donor group. Chelation through hydrogen bonding was found to shift the C = O band to longer wavelengths by about 0·15μ to 0·20μ, or 40 cm^{-1}. to 53 cm^{-1}., and to increase its intensity. Similar effects were observed for the carbonyl band of the enol forms of acetylacetone, ethyl malonate, ethyl acetoacetate. The magnitude of the effects of hydrogen bonding on the carbonyl band shows that energy changes in the proton-acceptor groups cannot be neglected in the computation of the energy of the hydrogen bond from spectroscopic data. The results also show that measurements on the proton-acceptor group can often be used as criteria for the presence of hydrogen bonding when experimental difficulties prevent accurate measurements of the effects on the vibrational band of the proton-donor group. Smaller effects were noted for ethylenic linkages of some of these compounds. [See Abstracts 1171 and 1336 (1940).] AUTHOR.

***2646. Infra-red investigation of H linkages.** H. HOYER. *Zeits. f. phys. Chem. B*, **45,** 5, *pp.* 389–410, 1940.—The construction of an apparatus for measurements in the short-wave, non-photographic infra-red is described. To determine the position of the first harmonic of the valency vibration of hydroxyl groups that take part in the formation of H-linkages or bridges, absorption spectrographs were taken of *o*-nitrophenol, salicilic acid methyl ester, and salicilic acid ethyl ester, and also of the corresponding heavy compounds in the hydroxyl group formed by replacement of the

hydroxyl hydrogen atoms by D_2O, in the region of about $1{\cdot}3\mu$ to $2{\cdot}7\mu$. The differences in extinction between the molecules containing OH and those containing OD were determined experimentally and separately in this region and thus the first harmonic of the H bridge was obtained, the supposed absence of which in the spectra has been made the basis for theoretical conclusions. S. G. B.

2647. Ultra-violet absorption spectra of nitrogenous heterocyclic compounds. Part I. Effect of *p*H and irradiation on the spectrum of adenine. J. R. Loofbourow and M. M. Stimson. *Chem. Soc., J., pp.* 844–848, *July*, 1940.—Examination of the ultra-violet absorption spectrum of adenine over a wide range of *p*H showed, contrary to previous reports in the literature, that the spectrum of this compound in aqueous solution is appreciably influenced by *p*H. The possible relationship of tautomerism to this effect is considered. Ultra-violet irradiation of adenine resulted in little change of absorption as compared with that observed in other purines and pyrimidines. Authors.

2648. An experimental study of the near ultra-violet absorption spectrum of benzene. W. F. Radle and C. A. Beck. *J. Chem. Phys.*, **8,** *pp.*507–513, *July*, 1940.—The wave numbers and relative intensities of 500 of the absorption bands of benzene vapour in the 2 600 Å region have been determined. A detailed study has been made of the variation of intensity with temperature of the main band of the *A*, *B*, and *D* progressions. These 3 bands have been assigned to the ground state, the 606 cm^{-1}. and 2×606 cm^{-1}. vibrational states, respectively, by Sponer and collaborators. The experimental data are in good agreement with a statistical calculation of the population factors for these states. Authors.

2649. A complex band-spectrum associated with an oxide of silicon. R. C. Pankhurst. *Phys. Soc., Proc.*, **52,** *pp.* 707–709, *Sept.*, 1940.—A band system of complex structure, ascribed to an oxide of silicon, possibly SiO_2, is described. The source was a heavy-current discharge tube with a quartz constriction. The spectrum was photographed under high dispersion and appears to be an extension of one previously reported by Cameron. Author.

2650. Note on the Stark effect of anomalous lines of mercury spectrum. Y. Ishida and S. Hiyama. *Inst. Phys and Chem. Research, Tokyo, Sci. Papers, No.* 966, *pp.* 227–231, *May*, 1940.—[See Abstract 470 (1940).] The Stark effect of several lines which belong neither to the normal nor to the ionized mercury spectrum has been observed and the results are tabulated.

2651. The normal oscillations and the configuration of hydracine. J. Goubeau. *Zeits. f. phys. Chem. B*, **45,** 3, *pp.* 237–248, 1940.—The Raman spectrum of liquid hydracine was photographed at various temperatures and with various exciting lines. A number of new lines were found, some which coincided with infra-red bands whilst others must be ascribed to the association of the hydracine. [See Abstract 4058 (1939).] S. G. B.

2652. Raman effect in Rochelle salt crystals. T. M. K. Nedungadi. *Indian Acad. Sci., Proc. A*, **11,** *pp.* 413–421, *May*, 1940.—In a careful study of the Raman spectrum of a single crystal of Rochelle salt 25 distinct Raman shifts are recorded along with 4 water bands, many of them being reported for the first time. These shifts are compared with those observed by the author in a saturated solution of the salt in water. The intensities of many of the Raman lines change markedly for varying orientations of

the crystal axes with respect to the directions of incidence and observation even when the incident light is unpolarized. Those lines which change in intensity conspicuously with orientation of the crystal are presumably to be classed as the symmetrical oscillations, while those which do not show any change are similarly included under antisymmetric oscillations.

AUTHOR.

2653. Raman spectra of amino acids and related compounds. Part V. J. T. EDSALL AND H. SCHEINBERG. *J. Chem. Phys.*, **8**, *pp.* 520–525, *July*, 1940.—Raman spectra are reported for $CH_3 \cdot ND_2$, $CH_3 \cdot ND_3^+$, $^+D_3N \cdot ND_3^+$ and $^+D_3N \cdot ND_2$. Comparison with the spectra of the corresponding compounds containing no deuterium reveals 3 classes of frequencies: (1) Those arising from the methyl group are unchanged within the experimental error by deuterium substitution in the amino group. (2) The amino and ammonium group frequencies are higher in the H than in the D compounds by a factor of 1·33 to 1·36. Among these a characteristic $-ND_3^+$ valence vibration is found near 2180 cm^{-1}. corresponding to an $-NH_3^+$ vibration near 2970. These frequencies are broad and rather faint, and are lower by several hundred wave numbers than the corresponding sharp intense lines arising from the uncharged $-NH_2$ and $-ND_2$ groups. The principal deformation frequency of the NH_3^+ and NH_2 groups appears to be near 1620; the corresponding frequency of the $-ND_3^+$ and $-ND_2$ groups is near 1200. (3) Other frequencies are changed by a factor $< 1 \cdot 3$ when deuterium is substituted for hydrogen in the nitrogen. The most intense lines in this group are the C — N and N — N stretching frequencies near 1000 cm^{-1}., which show a decrease of 20 to 50 cm^{-1}. on deuterium substitution. Some calculations, based on a very simple model, were made for these frequencies, but they did not quantitatively explain the observed results. [See Abstracts 3132 and 4081 (1937) and 1662 (1938).]

AUTHORS.

2654. Infra-red and Raman spectra of polyatomic molecules. B. L. CRAWFORD, JR. *J. Chem. Phys.*, **8**, *pp.* 526–531, *July*, 1940.—The infra-red absorption of methyl acetylene gas has been studied between 2·5 and 25μ; the Raman spectrum of the liquid has been measured. A complete vibrational analysis is given, and the thermodynamic properties of the gas, between 250° and 1000° K., are tabulated. A normal co-ordinate treatment has been carried out, in which all force constants were determined *a priori* from other molecules. The 10 fundamentals are calculated with an average error of 1·1, and a maximum error of 2·3%. [See Abstract 4068 (1939).]

AUTHOR.

2655. The absorption of phenyl mustard oil in the 4·8μ region. D. WILLIAMS. *J. Chem. Phys.*, **8**, *pp.* 513–516, *July*, 1940.—An intensive study of the 4·8μ band of phenyl mustard oil has shown this band to have 3 components. Although these components have not been completely resolved, the present work indicates the frequencies involved to be 2130, 2080, and 1950 cm^{-1}. The 2 highest frequencies have counterparts in the Raman spectrum, but the frequency 1950 cm^{-1}. has not been observed by Raman methods. Fermi resonance is discussed as a possible explanation of the observed spectrum. Re-investigation of the spectra of the methyl, ethyl, and phenyl nitriles and isonitriles failed to reveal complexities in the region of 2100 cm^{-1}.

AUTHOR.

***2656. A new mounting for an industrial grating spectrograph.** J. H. Dowell. *Journ. Sci. Instruments*, **17**, *pp.* 208–211, *Aug.*, 1940.—A grating spectrograph in which the mount of the grating and plateholder are so connected by levers that all necessary adjustments can be made by the movement of a single lever indicating on a wavelength scale. An arrangement is adopted in which minimum anastigmatism is obtained towards the ultra-violet end of the spectrum. Author.

***2657. Residual photometric errors in the commercial recording spectrophotometer.** O. W. Pineo. *J.O.S.A.*, **30**, *pp.* 276–289, *July*, 1940.—The advantage of the spectrophotometer over the eye, in giving a quantitative record for future reference or interlaboratory comparison, cannot be utilized effectively in some applications unless its accuracy corresponds to the closest tolerances in direct visual comparisons. Although negligible for some purposes, errors due to stray light in the commercial recording spectrophotometer are significant by this criterion. Specific recommendations are given for reducing the individual sources of stray light and for compensating the remainders by adjustment of the photometric scale. Author.

***2658. An improved high-speed recording spectrophotometer.** G. R. Harrison and E. P. Bentley. *J.O.S.A.*, **30**, *pp.* 290–294, *July*, 1940.—An automatic recording spectrophotometer designed to cover the range 10 000 to 2 000 Å is described. With present light sources the instrument will trace absorption curves at high speed from 9 800 Å to 3 400 Å and can be used somewhat more slowly to cover the spectrum to 2 300 Å. A 10 ft. concave grating monochromator with fixed slits is used to provide a pectral band 0·5 to 10 Å wide, the purity available depending on the light intensity and the speed of recording desired. An 11-stage electron multiplier is used to balance a light beam, which has passed through the sample to be measured, against the same beam later reduced by a photometric disc by a recorded amount. An electric " memory " device is used to accomplish this balance, and at the instant of balance a spark is passed through a piece of suitable graph paper wrapped around a rotating cylinder. Twenty absorption measurements can thus be made and recorded per sec. The instrument will plot either transmission or density values against wavelengths on a linear scale, to an accuracy of about 1%. Authors.

***2659. A mass spectrometer for routine isotope abundance measurements.** A. O. Nier. *Rev. Sci. Instruments*, **11**, *pp.* 212–216, *July*, 1940.—A mass spectrometer suitable for routine isotope analyses of carbon, nitrogen and other light elements which may be put in the gaseous or vapour form, is described. Although a simple, relatively inexpensive magnet consuming little power is used, good resolution is obtained. Author.

***2660. A precision spectrophotometer for use in the range 450 to 820 mμ.** S. Jacobsohn, H. E. Bent and A. J. Harrison. *Rev. Sci. Instruments*, **11**, *pp.* 220–226, *July*, 1940.—A precision photo-electric spectrophotometer is described which illuminates absorption cells with light which has passed through 2 monochromators, the half-intensity width of the spectral region isolated being from 5 to 10 mμ. Cells 20 cm. long and as much as 14 cm. in diameter may be used when it is necessary to work at low or high temperatures with thermo-stated equipment. The detector is a null instrument, giving a sensitivity of $0{\cdot}0001\,I_0$ and an accuracy, under favourable conditions in the optical density, within 0·1%. Authors.

VISION.

2661. Hue saturation and lightness of surface colours with chromatic illumination. D. B. Judd. *J.O.S.A.*, **30,** *p.* 296, *July*, 1940.—*Erratum* to Abstract 788 (1940).

2662. Nerve messages in the fibres of the visual pathway. H. K. Hartline. *J.O.S.A.*, **30,** *pp.* 239–247, *June*, 1940.—The paper reviews the information that has been obtained from measurement on the impulses transmitted along single fibres of the optic nerve. Changes produced by variations in duration, intensity and wavelength, of the stimulus are discussed and the relation of the results to the photochemical reactions in the retina indicated. The large differences found in the vertebrate eye in the type of discharge from different fibres are illustrated. Some new results on the area of the retina supplying a single optic nerve fibre are described. The experiments reviewed emphasize the necessity for considering patterns of activity in the nervous system in any analysis of the visual function. W. D. W.

X-RAYS.

2663. Reflection of X-rays with change of frequency. Parts I, II and III. C. V. Raman and P. Nilakantan. *Indian Acad. Sci., Proc. A*, **11,** *pp.* 379–408, *May*, 1940.—These papers deal with a new type of X-ray reflection in crystals which is dynamic in character and thus differs from the static reflections of the Laue type. Part I considers the broad theoretical aspects. The optical analogy of the scattering of light in crystals indicates that when X-rays traverse a crystal they excite pulsations in the crystal lattice having the characteristic infra-red frequencies, and these pulsations in turn cause periodic variations in the structure-amplitude of the crystal spacings and therefore result in reflections of the X-rays with change of frequency. At the Bragg angle of incidence the modified and unmodified reflections are superposed, but when the incidence is increased or decreased, the unmodified reflections disappear, thus enabling the modified reflections to be observed by themselves. They are seen in the plane of incidence on the crystal spacing, but at an angle greater or less than that of geometric reflection by the crystal planes. The modified reflection is a quantum effect and is not primarily a thermal phenomenon, though for low lattice frequencies or at high temperatures it may be thermally influenced. Part II describes the experimental results obtained by the study of the modified reflection from the (111) planes in diamond. The lattice vibration which is effective is that characteristic of the crystal which also appears in light-scattering with a frequency of 1 332 cm^{-1}. This is confirmed by the character of the effects as described in detail. Diamond exhibits a diffuse halo with a distinct darkening at the centre of the pattern and a maximum of intensity at a distance from it. This is explained as due to acoustic h.f. waves excited by the incident monochromatic X-rays and reflecting them in the usual way. Part III describes the results obtained with $NaNO_3$ which exhibits intense modified reflection by several of the crystal spacings. The geometric law of modified reflection is discussed in relation to the experimental data for both crystals. A study of the temperature effects observed with $NaNO_3$ indicates that a diminution in the intensity of the unmodified reflection is accompanied by an increase in the intensity of the modified reflection. The modified reflections therefore play an important part in the theory of the temperature effect in X-ray diffraction. Authors.

2664. Energy absorption. W. V. Mayneord. *Brit. J. of Radiology*, **13**, *pp.* 235–247, *July*, 1940.—It is suggested that the conception of X- and γ-ray dosage based on energy absorption at a point in tissues leads to an over-simplification of the problem, since energy absorption in a cell may not be the sole factor determining biological effects. There is evidence that the changes produced in any one cell are governed to some extent by damage caused to the neighbours. These considerations suggest the importance of the total energy absorbed by the body, and the paper is devoted to means of calculating this. First it is shown that the energy absorption per röntgen per gm. of air is about 85 ergs, and from this value absorption of energy in irradiated volumes of other tissues is calculated. The calculations are based on depth-dose curves, and a simple mechanical means of performing certain integrations is described. Typical examples from actual therapeutic conditions are given. G. E. B.

2665. Note on thin quartz crystals as used in the Cauchois focusing X-ray spectrograph. F. R. Hirsh, Jr. *Phys. Rev.*, **58**, *pp.* 78–81, *July* 1, 1940.—Doubled X-ray lines, produced by the Cauchois focusing spectrograph, have their origin as a result of double curvature of the crystal which causes defocusing of strong surface layer reflections. At the centre of the lines shown in this paper is a single portion, where the surface layer reflections are superposed as a result of Cauchois exact focusing, showing that the surface layers share in the uniform strain of the crystal. Calculated separation of doubled lines, on the assumption of parallelism of surface layer reflections, shows poor agreement with the actual separations, adding support to the idea of the origin of the doubled lines as a result of crystal warping. The breaking of bent crystals is attributed to the presence of this double curvature. Broadened lines due to light etching are the result of poor resolving power of the thinned surface layers which still do the bulk of reflection. Author.

See also Abstract 2714.

HEAT.

CALORIMETRY.

See Abstracts 2535, 2675.

DILATATION.

2666. The relation between the coefficient of thermal expansion and structure of solutions. R. Wright. *Chem. Soc., J., pp.* 870–873, *July*, 1940.—The coefficient of thermal expansion of a solution of a polar solute in a less polar solvent is to a large extent independent of the concentration. This phenomenon may be explained on the assumption that in concentrated solutions the molecules of the polar solute are linked together to form a continuous mesh-work which extends throughout the solution; so that the system may be compared to a porous substance containing a certain amount of free liquid inside the pores. Author.

2667. Length changes of whiteware clays and bodies during initial heating with supplementary data on mica. R. F. Geller and E. N. Bunting. *Bureau of Standards, J. of Research*, **25,** *pp.* 15–40, *July*, 1940. —Changes in length during initial heating from room temperature to a maximum of 1 250°C. were observed on 9 kaolins, 4 ball clays, and 3 whiteware bodies. The effects of various forming methods, admixtures and heating rates, were observed also. Supplementary data were obtained in the form of differential heating curves for 2 clays, and of specific gravity and weight-loss determinations for muscovite mica. Mica exerts the greatest influence of any one factor below 1 000°C. and particle size is the predominating factor above this temperature. Authors.

FUSION AND SOLIDIFICATION.

2668. Solidification in normal liquids and in liquids having a fixed structure such as rubber and artificial resins. K. Ueberreiter. *Zeits. f. phys. Chem. B*, **45,** 5, *pp.* 361–373, 1940.—Every liquid possesses a definite structure, its particles being disposed in a definite way dependent on their shape and the forces influencing them. This structure has a relaxation time which, above the melting point, is between 10^{-12} and 10^{-10} sec. and below the melting point may amount to days or weeks. On cooling a region is reached where the speed of cooling outstrips the relaxation period ; the result is freezing. If the speed of cooling is constant sharp angles appear in the volume/temperature curve which mark the region where freezing is manifest. The freezing region for rubber which is stable in form, contrary to expectation, is 14° below that for tricresyl phosphate, which is slightly liquid at room temperature. The elasticity of rubber is due to stretching of the macro-structure, at the same time the necessity for freedom for the micro-Brownian movement demands a low-lying freezing region. This is found in unvulcanized and synthetic rubber in the neighbourhood of — 65°C. S. G. B.

See also Abstract 2535.

TEMPERATURE.

2669. An experimental study of heat interchangers. R. B. Jacobs and S. C. Collins. *J. of Applied Physics*, **11,** *pp.* 491–495, *July*, 1940.—Recent developments of engines and turbines for producing low temperatures have emphasized the necessity of improved heat interchangers for further progress in the field. The present report covers an experimental investigation of heat interchanger design and operation intended primarily to cover those applications most likely to occur in the experimental rather than in the commercial laboratory. Authors.

THERMOCHEMISTRY.

2670. The influence of a solvent on the strength of the hydrogen bridge. E. A. Moelwyn-Hughes. *Chem. Soc., J., pp.* 850–855, *July*, 1940.—The distribution of acetic acid between benzene and water has been examined experimentally over wide temperature ranges and at lower concentrations than in previous work. The increase in internal energy attending the dissociation of the double molecule in benzene solution is found to be some 5 400 cal. less than the corresponding value for the gaseous dissociation. The difference in the 2 energies is quantitatively

related to the distance apart of the polar solute molecules in combination, to the number and average distance of neighbouring solvent molecules round the dimer, and to the polarizability of the solvent molecules.

AUTHOR.

2671. The determination of the thermodynamic dissociation constants of dibasic acids. J. C. SPEAKMAN. *Chem. Soc., J., pp.* 855–859, *July*, 1940.—Two difficulties have to be overcome in determining the thermodynamic dissociation constants of a dibasic acid from experiments on cells embodying liquid-liquid junctions : first, that of the standardization of the *p*H scale ; and secondly, that of correcting for the activity effects of the ions. A procedure for overcoming these difficulties is suggested. Previous general formulae are modified so as to lead to a linear equation, which enables first and second dissociation constants to be obtained very simply, and the use of which is very convenient in smoothing experimental data and leads to no appreciable errors in dilute solutions. The method has been tested by experiments on oxalic, succinic, glutaric and adipic acids, and found to be satisfactory. AUTHOR.

See also Abstract 2585.

THERMODYNAMICS.

2672. Extension of the heat conductivity method for measurement of the molecular heat of very rarified gases. A. EUCKEN AND H. KROME. *Zeits. f. phys. Chem. B*, **45,** 3, *pp.* 175–192, 1940.—The method consists in using a heated Pt band instead of the usual heating wire, in close proximity to which is an unheated fine Pt wire which is heated by the moving away of the molecules from the band. Thus their primary temperature and, subsequently, the accommodation coefficient is ascertained. S. G. B.

2673. Calculation of the free energy of formation from the ternary diagram of state. F. HALLA. *Zeits. f. phys. Chem. A*, **185,** 6, *pp.* 426–434, 1940.—Taking simple conditions (the ratio of the activity coefficients to each other being $=1$), the free energies of formation can be calculated from the concentration values of certain definite phase points of a ternary diagram. The method is explained by means of examples. S. G. B.

2674. Energy and entropy of liquid surfaces. H. CAMPBELL AND D. D. ELEY. *Faraday Soc., Trans.*, **36,** *pp.* 854–856, *Aug.*, 1940.—A linear relationship is found to hold between the heats and entropies of formation of liquid surfaces, if molar surface energies and entropies are used. The approximate value $\mu = \gamma(M/\rho)^{\frac{2}{3}}$ is used for the molar surface free energy. The linear relationship is shown graphically for 40 results due to Timmermans and Hennaut-Roland, together with 6 by Jaeger. E. E. W.

See also Abstracts 2654, 2691.

VAPORIZATION AND CONDENSATION.

2675. The coefficient of vaporization of polar crystals. K. NEUMANN AND V. COSTEANU. *Zeits. f. phys. Chem. A*, **185,** 2, *pp.* 65–80, 1939.—By means of a newly-designed apparatus the vapour pressures of potassium perrhenate are measured by means of Knudsen's method. From the results the heat of evaporation and the heat of fusion are calculated. S. G. B.

***2676. The construction and cooling of large vapour traps.** D. L. NORTHRUP, C. M. VAN ATTA AND L. C. VAN ATTA. *Rev. Sci. Instruments*, **11,** *pp.* 207–210, *July*, 1940.—A description is given of a simple and efficient baffle system which results in a vapour trap of high conductance for permanent gas. Two methods for maintaining the temperature of the trap in

the range — 50° to — 80°C. are described, one designed for intermittent and one for continuous operation. Measured conductances and over-all performance characteristics are given. AUTHORS.

2677. The volatility of small particles of crystalline salts, with and without polymorphous change. N. KOLAROW. *Kolloid Zeits.*, **90**, *pp.* 294–298, *March*, 1940.—The course of the (vapour pressure)/(size of grain) curve is different for RbCl and RbBr, which undergo no polymorphous change up to their melting point, from those of Rb_2SO_4 and Cs_2SO_4, which do undergo polymorphous change. In the former case the curve has a minimum and in the latter case it has not. The method proposed by the author and Balarew for determination of the location of the minimum in the curve relating vapour pressure to grain size gave satisfactory results, and Balarew's generalization, that the disperse structure of solid systems has a thermodynamic basis, is correct. S. G. B.

See also Abstracts 2535, 2540.

ACOUSTICS.

2678. Effect of supersonic waves on colloidal phenomena. Investigation of the effect on solutions of cane sugar. N. SATA AND Y. HARISAKI. *Chem. Soc. Japan, Bull.*, **15**, *pp.* 180–185, *May*, 1940. *In German.*—It was found that the angle of rotation did not change after exposure for 60 min. The iodometric sugar analysis, with and without Fehling's solution, was first accurately tested under different conditions and satisfactory results obtained. It was established that an aqueous solution of pure cane sugar, which possessed initially a small reducing power, had this power slightly increased by supersonic waves. Since the latter effect was not only very small but also was scarcely increased by long exposure to supersonic vibrations, it was concluded that changes of intensity and frequency of supersonic waves exerted no influence on the inversion of cane sugar. H. H. Ho.

2679. Splitting of macromolecules by supersonic vibrations. G. SCHMID AND O. ROMMEL. *Zeits. f. phys. Chem. A*, **185**, 2, *pp.* 97–139, 1939.—Dilute solutions of polystrol, polyvinyl acetate, polyacrylic acid esters, nitro-cellulose and rubber, were exposed to the action of powerful supersonic waves of 284 kc./s. The viscosity of the solutions was considerably reduced by the treatment, especially where substances of high polymeric value were used. This decrease in viscosity, which is, in general, irreversible, indicates depolymerization of the dissolved substance. It is assumed that the molecules are ground down by the vibrating liquid, and they have an inhibiting effect in regard to current movements in certain concentrations, forming a loose network through the meshes of which flows the vibrating liquid. The experiments have a practical significance in the spinning solutions of rayon manufacture, where a convenient method of shortening long thread molecules is required. S. G. B.

2680. Ultra-sonic velocity in carbon dioxide and ethylene in the critical region. C. M. HERGET. *J. Chem. Phys.*, **8**, *pp.* 537–542, *July*, 1940.—Measurements of the velocity of ultra-sonic waves in carbon dioxide and

ethylene are presented; the velocity was obtained while the gas was allowed to follow a p–v isothermal. For carbon dioxide the pressure range is 5 to 98 atm. at temperatures of 28·0°, 30·0°, 31·0°, 32·0°, 33·0°, 35·0° and 38·0°C. For ethylene the pressure range is 35 to 75 atm. at temperatures of 9·7°, 18·7° and 23·0°C. For both gases, as pressure increases the velocity decreases, falls to a sharp minimum, and then rises steeply on the high-pressure side of this minimum. The minima have a discontinuity of slope for isothermals below the critical isothermal, which persists for a limited temperature range above the critical temperature. Above this range the curves become continuous in slope through the minimum. The curve log p *vs.* $1/T$ for the minima is linear through the critical point and, below the critical point, coincides within experimental error with standard vapour pressure data. Some calculations of ratio of specific heats near the critical point are included. AUTHOR.

ELECTRICITY AND MAGNETISM.

CONDUCTION IN SOLIDS AND LIQUIDS.

2681. Equilibrium and movement of superconductors. N. FELICI. *Ann. de Physique*, **13**, *pp.* 266–349, *May–June*, 1940.—The first principle of all electronic explanations of superconductivity is that the resultant magnetic field produced by external causes and by the super-currents is zero. The relations between current and magnetic field on one hand and between charges and electric field on the other hand are interconnected. The superconductor appears to be a simple case of an ordinary conductor. This view is supported by the relation between superconductivity and magnetic field, the absence of the Hall effect, etc. Relativity considerations lead to an explanation by a single electro-magnetic theory from which can be derived the general law governing the movements of superconductors. G. G.

2682. Dependence of conductance on field strength. Part II. Tetrabutylammonium bromide in diphenyl ether at 50°. D. J. MEAD WITH R. M. FUOSS. *Am. Chem. Soc., J.*, **62**, *pp.* 1720–1723, *July*, 1940.—[See Abstract 4136 (1939)]. The conductance of tetrabutylammonium bromide in diphenyl ether at 50° has been measured at low voltage over the approximate concentration range 10^{-6} — 10^{-3} normal. Conductances at 60, 600 and 1 000 c./s. at field strengths up to 20 kV/cm. were measured in the concentration range $0{\cdot}5$–$5{\cdot}0 \times 10^{-4}$ N. For low frequencies the Wien effect is in agreement with Onsager's theory; when the Langevin time of relaxation becomes comparable with the period of the impressed field, a dispersion of the Wien effect appears. AUTHORS.

See also Abstracts 2692, 2719, and
1669B. Resistances independent of temperature. F. Hildebrandt.

DIELECTRICS AND CAPACITANCE.

2683. The dipole moments and intermolecular association of polyvalent alcohols. Y. L. WANG. *Zeits. f. phys. Chem. B*, **45**, 4, *pp.* 323–328, 1940.—Measurements are given of the densities and the dielectric constants

of solutions of water and certain polyvalent alcohols in dioxane and of ethyl mercaptan in benzene. From these measurements the dipole moments of these substances are determined. The results are set out in a series of tables. S. G. B.

2684. Use of the wave guide for measurement of micro-wave dielectric constants. H. R. L. Lamont. *Phil. Mag.*, **30**, *pp.* 1–15, *July*, 1940.—A magnetron oscillator working at wavelengths of from 15 to 25 cm. generates oscillations inside a wave guide consisting of a hollow copper cylinder 5 ft. long and of diameter 7 in. In the first method the guide is filled with liquid and the change of resonant wavelength is measured. In the second method a short cylinder of solid dielectric is fitted loosely inside the guide and the change in resonant wavelength determined for different positions of the solid block. The third and fourth methods are modifications of the second, the fourth method being an adaptation for the use of liquid dielectrics. From each of these methods the dielectric constant may be determined. Results are given for liquid paraffin, paraffin wax and polystyrene, whose dielectric constants are 2·19, 2·22 and 2·57, respectively. J. P. A.

2685. The dielectric behaviour of anodic Al during its formation. A. Miyata. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 961, *pp.* 147–176, *April*, 1940.—Dielectric measurements on anodic Al during formation with constant current densities were carried out. The equivalent series capacitance and loss angle at low frequencies of the active layer increased during formation with increase of forming current, but no variations were found with h.f. The *p*H value of the forming solution also had a considerable influence on the loss angle with bare Al but was without effect with filmed Al. Similar differences were also found with variation of the measuring potential. By means of an oscillograph it was demonstrated that the formation of anodic Al is accompanied by frequent spasmodic discharges, particularly with bare Al and with alkaline solutions. A. M. T.

2686. The frequency characteristics of anodic Al during formation. A. Miyata. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 962, *pp.* 177–204, *April*, 1940.—The frequency characteristics of anodic Al during formation were studied, dielectric measurements being made with frequencies ranging from 50 c./s. to 10 000 c./s. The results obtained are analysable by reference to a simple equivalent network consisting of a leakage resistance in parallel with a series circuit of resistance and capacitance. It is supposed that the dielectric absorption occurs in the solution just outside the active layer which is almost without loss and has a capacitance strictly proportional to the forming voltage. The differences found between the active layer formation on filmed and bare Al are also explained. It was found that the capacitance C of the active layer expressed in μF/cm^2. is connected with the forming voltage V by the equation $C = 6{\cdot}54/V$. A. M. T.

2687. The magnitude of the solvent effect in dipole-moment measurements. Part III. Polarization and association of alcohols in the liquid phase. F. R. Goss. *Chem. Soc., J., pp.* 888–894, *July*, 1940.—The dielectric polarization of alcohols and their solutions is known to be highly abnormal, in agreement with the exceptional behaviour exhibited by their other physical properties such as vapour pressure, surface tension, and viscosity. The deviations of these liquids from the normal are commonly ascribed to some form of association, at one time thought to result in the

formation of non-polar double molecules, but now shown to depend on the resonance of the molecules which may cause either an increase or a decrease in polarization. On the basis of the solvent-effect equation introduced in Part I and the correlated equations interrelating the polarization constants developed there and elaborated in Part II [Abstract 2503 (1940)] it is now possible to calculate the ideal polarization values which the alcohols would have if association could be eliminated. Consequently the ratio of the observed partial orientation polarization of alcohols in admixture with benzene to these ideal values is an association factor which indicates the incidence of the abnormal behaviour in so far as polarization is concerned. This factor is shown to vary, for the straight-chain alcohols, in close approximation to the $\frac{2}{3}$ power of the number of carbon atoms. The ideal dielectric constants of the unassociated alcohols are also calculated, and it is shown that in dilute benzene solution the alcohols behave normally, in agreement with cryoscopic observations. The pronounced minimum in the partial polarization curve of the alcohols in admixture with carbon tetrachloride is discussed and is attributed to a heterogeneous association. AUTHOR.

2688. A relation between the activation energies of reactions in solution and the dielectric constants of the media. The measurement of activation energies in solution. D. P. EVANS AND H. O. JENKINS. *Faraday Soc., Trans.*, **36**, *pp.* 818–823, *Aug.*, 1940.—A relation of the form $E = E_B + E_X/\epsilon$ has been suggested between activation energies in solution and the dielectric constants of the media. The equation permits of the evaluation of the order of magnitudes of the bond-stretching and repulsion energies. Further, the variation of activation energy with the reciprocal of the dielectric constant is shown to be expected only when the repulsion energy, E_R, is a sufficiently large fraction of the total activation energy The validity of the usual method of determining activation energies for reactions in solution is questioned. AUTHORS.

ELECTROCHEMISTRY.

2689. The silver—silver iodide electrode. R. K. GOULD AND W. C. VOSBURGH. *Am. Chem. Soc., J.*, **62**, *pp.* 1817–1819, *July*, 1940.—Measurements have been made at several temperatures of the e.m.f. of the cell H_2/HI/AgI, Ag, with an acetate buffer containing potassium iodide as the electrolyte, and the values of E^0 calculated. AUTHORS.

2690. Influence of external resistance in the cell circuit on the maxima in polarographic current/voltage curves. J. J. LINGANE. *Am. Chem. Soc., J.*, **62**, *pp.* 1665–1669, *July*, 1940.—The suppressive effect of increasing resistance in the cell circuit on the maximum in the polarographic c. v. curve of mercurous ions, first discovered by Brdicka, has been confirmed. It has also been found that the maxima of O, Pb-ions, Ni-ions, and Zn-ions, are all more or less suppressed by a large resistance in series with the cell, and it is concluded that the effect is of general occurrence. An explanation of this effect has been given, based on the fact that the e.m.f. actually applied across the cell decreases during the life of each mercury drop when a large external resistance is in series with the cell. AUTHOR.

2691. Electrolytic dissociation of dicarbonic acids in water and aqueous alkali solutions. B. ADELL. *Zeits. f. phys. Chem. A*, **185**, 3, *pp.* 161–206, 1939.—The author has measured electrometrically the various concentration constants in aqueous NaCl and KCl solutions and determined the thermodynamic constants of some normal dicarbonic acids. Further

activity functions are calculated from these constants. The change in the dissociation constants and activity functions with the nature and concentration of the alkali chloride, and especially with the nature and number of the members between carboxyl groups in the acids, is discussed. From the quotient of the first and second thermodynamic dissociation constants of the acids the distance between the carboxyl groups is calculated. The variation of this quantity with the number and nature of the intermediate members is studied. S. G. B.

2692. H-ion concentration in the forming solution of anodic Al. A. Miyata. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 967, *pp.* 232–273, *May*, 1940.—The importance of choice of solution for anodic Al formation is discussed, with the preliminary treatment of the sample to be tested with respect to polishing, cleansing and annealing. The anodic behaviour of both bare and filmed Al is described in detail. The forming solutions with *p*H values in the range 4 to 8·5 are obtained by adding NH_4OH to boric acid solutions. The external appearance of the Al at various stages is described. The formation of bare Al is preferable in a slightly alkaline solution, and that of filmed Al is favourable in a faintly acidic solution. When bare Al is formed over a long time in acid media it is generally covered with a relatively thin but dense waste layer, and that in alkaline solutions is covered with a relatively thick but porous waste layer. When filmed Al is formed over a long time, the samples in all the solutions tested showed a fairly small capacitance, although the effect of absorption (polarization) to reduce the anodic capacitance could never be perceived at the instant when its voltage rose to the full value. H. H. Ho.

2693. Electron emission into dielectric liquids. W. R. LePage and L. A. DuBridge. *Phys. Rev.*, **58,** *pp.* 61–66, *July* 1, 1940.—The current between polished Ni electrodes immersed in pure toluene has been measured as a function of electric field (over the range 0 to 250 000 V/cm.) and of temperature (from — 15 to 70°C.). The Richardson lines are straight but show a very small slope (0·05 to 0·4 eV) and a small value of the constant A (10^{-9} to 10^{-11} A/cm^2. deg^2.). The log $i/E^{\frac{1}{2}}$ curves show a slope about twice the value $e^{\frac{3}{2}}/D^{\frac{1}{2}}kT$ predicted by the simple Schottky theory, but in agreement with the theory of Baker and Boltz. It is found, however, that there are serious objections to this theory, and the agreement with it is probably accidental. The situation is in fact too complex to be handled by a simple theory. It is suggested that for the low potential barrier present at the metal-dielectric interface a combination of thermionic and field currents would be expected which would account qualitatively for the observed behaviour. Authors.

2694. The electrolytic phenomena at the anode as a hydroxyl effect. A. Klemenc. *Zeits. f. phys. Chem. A*, **185,** 1, *pp.* 1–36, 1939.—Oxidation at the anode is generally described as an effect of primarily discharged hydroxyl, the free diffusion of which is assumed. The Pt anode is regarded as an " Oxide " electrode thus enabling a number of anode phenomena to be clearly defined. The paper is both theoretical and experimental. S. G. B.

2695. The over-potential of Cd in presence of air. M. Straumanis and N. Brakšs. *Zeits. f. phys. Chem. A*, **185,** 1, *pp.* 37–44, 1939.—The curve for the hydrogen over-potential of Cd in presence of air and $N/10$ sulphuric acid is studied. The amount of over-potential is only reduced by the presence of O_2 in a region of low current densities. With low current densities, to about 0·3 mA/cm^2., the measured potential is at least partially

dependent on current density. An attempt is made to interpret the significance of the influence of oxygen on the cathode potential of Cd qualitatively.

2696. Experimental evidence for the secondary precipitation of metals on the cathode during electrolysis of complex salts. A. Glazunov, O. Starosta and V. Vondrásèk. *Zeits. f. phys. Chem. A*, **185**, 5, *pp.* 393–399, 1939.—The fact that a secondary process takes place when metals are precipitated on the cathode during electrolysis of complex salts was confirmed experimentally. Slender glass threads were stretched over the cathode surface. Quite early in the electrolysis (after 35–50 sec.) these threads were covered, like the cathode itself, with a thin layer of metal which was being precipitated on the cathode. S. G. B.

2697. Mechanism of the hydrogen electrode process: reply to the criticism of Frumkin and his collaborators. J. Horiuti. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 968, *pp.* 274–301, *May*, 1940.—The present position of the dual theory of the catalytic and the electrochemical mechanism of the hydrogen electrode process [Abstract 1828 (1936)] and Frumkin's criticism of the latter, summarized in 3 points, are treated.

See also Abstracts 2538, 2559.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

2698. Evidence against the existence of an excited state of He^3. R. D. Park and J. C. Mouzon. *Phys. Rev.*, **58**, *pp.* 43–46, *July* 1, 1940.—Cloud-chamber measurements have been made on the recoil protons produced by neutrons from the *d–d* reaction. The distribution of the neutron energies has been determined from 126 recoil proton tracks. No evidence for a low-energy group of neutrons, and consequently an excited state of He^3, was obtained. Authors.

2699. Classical theory of spinning particles. H. J. Bhabha. *Indian Acad. Sci., Proc. A*, **11**, *p.* 467, *May*, 1940.—**Errata,** see Abstract 2242 (1940).

2700. On elementary heavy particles with any integral charge. H. J. Bhabha. *Indian Acad. Sci., Proc. A*, **11**, *p.* 468, *May*, 1940.—**Errata,** see Abstract 2243 (1940).

2701. Magnetism and valency: Mn compounds. N. Goldenberg. *Faraday Soc., Trans.*, **36**, *pp.* 847–854, *Aug.*, 1940.—A comprehensive survey is made of the literature dealing with the magnetic moments of the simple and complex salts of Mn; the magnetic moments of 13 salts, mostly complex, have been measured. With the exception of the complex cyanides, the magnetic moments of the Mn salts so far measured are almost exactly those of the Mn ions present, indicating that the linkages concerned are electrostatic in nature. The magnetic moments of the double cyanides agree well enough with those forecast by Pauling, and indicate direct covalent binding of the co-ordinated CN groups. Author.

2702. On the resonance levels of Rh and In. J. Hornbostel, H. H. Goldsmith and J. H. Manley. *Phys. Rev.*, **58**, *pp.* 18–23, *July* 1, 1940.—Self-absorption curves as well as mutual absorption curves of the In and the Rh neutron capture levels have been measured. From the experiments the following values were obtained for the absorption coefficients for self-indication K_s, the resonance cross sections σ_0, the natural widths

Γ, the neutron width Γ_N and the spacing $| E_{0In} - E_{0Rh} |$ of the 2 levels: $K_s = 11{\cdot}5$ cm^2./gm., $\sigma_0 = 4100 \times 10^{-24}$ cm^2., $\Gamma = 0{\cdot}13$ eV, $\Gamma_N = 3{\cdot}5 \times 10^{-4}$ eV for Rh; $K_s = 52$ cm^2./gm., $\sigma_0 = 23000 \times 10^{-24}$ cm^2., $\Gamma = 0{\cdot}07$ eV, $\Gamma_N = 1 \times 10^{-3}$ eV for In; $| E_{0In} - E_{0Rh} | = 0{\cdot}15$ eV. AUTHORS.

2703. Transmutation of the separated isotopes of neon by deuterons. E. POLLARD AND W. W. WATSON. *Phys. Rev.*, **58,** *pp.* 12–18, *July* 1, 1940.—Under bombardment by 2·6 eMV deuterons, Ne is observed to emit a large yield of protons which fall into at least 4 groups of energy change values 1·02, 2·15, 3·13 and 4·88 eMV. To assign these to the appropriate isotope, samples of Ne enriched in Ne^{22} and Ne^{20} prepared by the thermal diffusion method were bombarded, with the result that all groups are found to correspond to excited states of Ne^{21}. The reaction involved is $Ne^{20}(dp)Ne^{21}$. The maximum energy of the protons leads to the value 21·000 17 for the mass of Ne^{21}. The bombarded gas was found to be radioactive and the presence of Ne^{23} due to $Ne^{22}(dp)Ne^{23}$ and Na^{21} due to $Ne^{20}(dn)Na^{21}$ was established. By absorption the β-rays from Ne^{23} were found to consist of a single group of maximum energy 4·1 eMV which leads to a probable value of 23·001 0 for the mass of Ne^{23}. AUTHORS.

2704. Radiative K capture. P. MORRISON AND L. I. SCHIFF. *Phys. Rev.*, **58,** *pp.* 24–26, *July* 1, 1940.—Accompanying K capture, as in β-activity, there is a weak, continuous, high-energy γ-ray spectrum. The major contribution to the effect is from magnetic radiative capture of a K electron. For an allowed transition using Fermi or Gamow-Teller coupling, the number of γ-quanta per K electron captured is $(\alpha/12\pi)(W/mc^2)^2$, where W is the available energy. For other couplings and forbidden transitions the effect is of the same order of magnitude. AUTHORS.

2705. Multiple scattering of electrons. Part II. S. GOUDSMIT AND J. L. SAUNDERSON. *Phys. Rev.*, **58,** *pp.* 36–42, *July* 1, 1940.—The series developed in a previous paper [Abstract 885 (1940)] representing the distribution for the multiple scattering of electrons has been evaluated numerically for a large number of cases; the results are given in a table. An approximate expression is found for the value of $\sin\theta$ averaged over the distribution per unit solid angle, $f(\theta)$. A series formula is derived for the projected scattering distribution as observed in a cloud chamber. AUTHORS.

2706. The scattering of thermal neutrons by deuterons. L. MOTZ AND J. SCHWINGER. *Phys. Rev.*, **58,** *pp,* 26–36, *July* 1, 1940.—The cross-section for the scattering of very slow neutrons by deuterons is calculated by numerical methods. Polarization is completely neglected and the wave equation for the process is set up in a form to take correctly into account exchange effects between the incident neutron and the neutron initially in the deuteron. This wave equation is then replaced by an integral equation the solution of which is correctly symmetrized and has the right asymptotic value to describe the scattering process. The numerical integration is performed by replacing the integral equation by a finite set of simultaneous linear algebraic equations. The work is greatly simplified by the use of a sum of 2 Gauss functions to approximate the ground state deuteron wave function. It is assumed throughout this paper that the interactions between like and unlike particles are equal. AUTHORS.

2707. Scattering of slow neutrons by some elements. N. KIMURA, *Phys. Math. Soc., Japan, Proc.*, **22,** *pp.* 391–397, *May*, 1940.—The scattering cross-sections of C and D neutrons are measured by the method of back scattering

for Ni, Fe, Pb, S, Bi, Zn, Hg, Ag and I. Hg is found to have a large C neutron cross-section compared with its D neutron cross-section. Scattering cross-sections for Ag and I are found to be independent of the neutron energy. E. E. W.

2708. Radiative processes involving fast mesons. F. Booth and A. H. Wilson. *Roy. Soc., Proc. A*, **175,** *pp.* 483–518, *July* 18, 1940.—The general theory of the interaction of mesons with an electromagnetic field is developed, starting from Kemmer's matrix formulation of the meson equations. The general theory is applied to the scattering of light by mesons, the emission of radiation by mesons during collisions and the production of pairs of mesons. A brief discussion of the experimental results on the energy losses of " heavy electrons " in cosmic rays is given, and it is shown that the experiments are consistent with the view that the heavy electrons have spin 1 and that the theory of the interaction of mesons with an electromagnetic field is probably valid for energies considerably greater than the rest energy of a meson. Authors.

***2709. A new electron microscope.** L. Marton. *Phys. Rev.*, **58,** *pp.* 57–60, *July* 1, 1940.—The design of a high-power electron miscroscope of the transmission type is described. It is constructed as a self-contained unit which may be operated by a practical microscopist who does not necessarily have training as a physicist. Microphotographs are shown which indicate that a resolving power of about 50 Å can be readily obtained. Author.

***2710. The lining of metal capillaries with glass and the application to a capillary positive ion source.** I. A. Getting and H. W. Leighton. *Rev. Sci. Instruments*, **11,** *pp.* 232–234, *July*, 1940.—A technique is described for the lining of metal capillaries with a thin coat of glass. The advantages of such capillaries in electrical discharges are pointed out. Use is made of such a capillary in a highly efficient positive ion source for h.v. nuclear research. Authors.

See also Abstract 2535.

MAGNETISM AND ELECTROMAGNETISM.

2711. A new treatment of electric and magnetic induction. G. B. Brown. *Phys. Soc., Proc.*, **52,** *pp.* 577–601 ; *Disc.*, 601–615, *Sept.*, 1940.—A new treatment of induction is suggested which, by considering " theoretical experiments" and the meaning of the terms " force on a pole " and " force on a current element", arrives at the definition of the internal field and the induction without involving an arbitrary selection of certain cavities. It is shown that the dielectric constant and the permeability are strictly analogous measures of the effects of polarization, and a definition of the permeability is given which resembles the definition of the dielectric constant. A very simple derivation of the formula known as the Clausius-Mossotti formula is given, and what would appear to be errors in the Mossotti-Jeans and Clausius-Lorentz treatments are pointed out. The use of the latter formula, it is suggested, may lead to errors in the calculated dipole moment. A proof is then given that the induced electromotive force depends on the change of induction and not on the change of force : this is rarely, if ever, proved satisfactorily in the text-books. A method of obtaining Maxwell's equations without invoking displacement currents is indicated. The effect of a polarizable medium on the forces between point charges, point poles, point poles and current elements, current

circuits and magnetic shells, and current circuits and actual magnets, is examined in detail. The 5 electromagnetic relations are re-stated with the effect of the medium explicitly mentioned, and the dimensionless nature of the dielectric constant and the permeability is stressed. AUTHOR.

2712. Artificial iron sulphides and the ferromagnetism of semi-conductors. S. MIYAHARA. *Phys. Math. Soc. Japan, Proc.*, **22,** *pp.* 358–364, *May*, 1940. *In German.*—A series of artificially prepared iron sulphides containing various amounts of dissolved sulphur was examined for magnetic susceptibility, by X-ray analysis, and for electrical conductivity. A sharp division between ferromagnetic and paramagnetic sulphides is found in the magnetic measurements, but the axial ratio of the hexagonal lattice varies continuously with the sulphur content throughout the whole range of composition. This indicates that the ferromagnetism arises from the electronic structure, and measurements of the variation of conductivity with temperature show that the materials conform to the author's theory of the ferromagnetism of semi-conductors [Abstract 4157 (1939)].

C. E. W.

MEDICAL RADIOLOGY AND ELECTROLOGY.

2713. Killing of bacteria with ultra-violet light. J. F. D. SMITH. *Frank. Inst. J.*, **229,** *pp.* 775–778, *June*, 1940.—The problem considered is that of a cylindrical duct with a centrally placed light source, through which passes a uniform flow of air containing at the entrance a given concentration of bacteria. The average value of the bacteria concentration at the exit from the duct is required. The resulting formula for $N_{\text{exit}}/N_{\text{entrance}}$ is obtained in the form of a convergent series. J. E. R.

***2714. X-ray cinematography in research.** A. E. BARCLAY, K. J. FRANKLIN AND M. M. L. PRICHARD. *Brit. J. of Radiology*, **13,** *pp.* 227–234, *July*, 1940.—This paper describes the apparatus at the Nuffield Institute of Medical Research, which is at present being used mainly for studies of the circulatory system. There are 2 separate equipments. One is of the "indirect type" in which the image formed on a fluorescent screen is photographed by means of a suitable camera having a large-aperture lens. Essentially this is similar to the apparatus devised by Reynolds, but modified for use in horizontal radiography and simplified. The other apparatus makes possible the taking of direct radiographs on film 5 in. wide at the rate of 3 frames per sec. G. E. B.

2715. Uses of differential media in radiography. O. M. ALEXANDER. *Radiography*, **6,** *pp.* 121–138, *July*, 1940.—A summary of the properties and uses of the important media used in radiography and some applications. The latter include bronchography, cholecystography, urography, pyelography, cystography, ventriculography, etc. The method of administration, radiographic technique and any special precautions required, are considered. G. E. B.

***2716. A simple localizer.** J. SCOTT. *Radiography*, **6,** *pp.* 143–145, *Aug.*, 1940.—The localizer consists of a right-angled triangular frame, made of metal or wood, with a heavy metal plate forming the hypotenuse, in which are holes drilled at regular intervals. A spring clip is incorporated at the right angle of the triangular frame, suitable for clipping the localizer to the cassette or film.

See also Abstract 2664.

OSCILLATIONS AND WAVES.

See Abstract 2684.

PHOTO-ELECTRICITY.

2717. The photogalvanic effect. Part I. The photochemical properties of the thionine-iron system. E. RABINOWITCH. *J. Chem. Phys.*, **8**, *pp.* 551–559, *July*, 1940.—Solutions containing thionine and ferrous salts are bleached by illumination and recover their colour in the dark. The kinetics of this reaction are investigated by measuring photometrically the concentration of the dye in the photostationary state. Equations are derived for this state in terms of the initial concentrations and light intensity. At low thionine concentrations the extent of bleaching is proportional to the first power of light intensity and inversely proportional to the concentration of ferric ions. The bleaching reaches a maximum at certain thionine concentrations and then decreases inversely proportional to the concentration of the dye. The bleaching increases strongly with increasing acidity. Kinetic mechanisms accounting for these relationships are discussed, and quantum yields and velocity constants are estimated. It is pointed out that the accumulation of free radicals (" semiquinones ") and the occurrence of " circular " mechanisms maintaining the steady state are typical of photostationary states as distinguished from true equilibria. AUTHOR.

2718. The photogalvanic effect. Part II. The photogalvanic properties of the thionine-iron system. E. RABINOWITCH. *J. Chem. Phys.*, **8**, *pp.* 560–566, *July*, 1940.—The oxidation-reduction system thionine-iron provides an extremely sensitive photogalvanic cell. The illuminated half-cell is negative in respect to the non-illuminated one. The photogalvanic potential ϵ^* is determined in relation to composition and light intensity. The results are in a qualitative (and partially quantitative) agreement with the kinetic theory of the photogalvanic effect. In strongly bleached solutions the electrode potential is maintained by semithionine ions transferring electrons to the electrode and ferric ions acquiring electrons from the electrode, whereas ferrous ions and leukothionine ions remain practically inactive. In weakly bleached solutions the mechanism is more complicated. AUTHOR.

See also Abstract 2660.

THERMIONICS.

2719. Conductivity and thermionic emission of the oxide cathode. E. NISHIBORI AND H. KAWAMURA. *Phys. Math. Soc. Japan, Proc.*, **22**, *pp.* 378–384, *May*, 1940.—A theory due to Fowler and Wilson [Abstract 5166 (1932)] suggests an intimate connection between the thermionic emission of the oxide-coated cathode and the electrical conductivity of the oxide. A diode is constructed in which the cylindrical Ni cathode is coated with BaO or SrO over its middle portion by the normal forming process. A Ni helix is embedded in the oxide at a small distance from the cathode cylinder of Ni, and an anode is made from a surrounding co-axial mesh. When a small anode voltage is used, a potential difference is established between the cathode and the embedded helix by the passage of the anode current. The ratio of this potential difference to the current is a measure of the conductance of the oxide, while the emission can be measured by obtaining the saturation anode current. Curves of results show a close relationship between conductance and emission. During the process of activation they both increase at similar rates. They are similar functions of the temperature. A short theoretical discussion leads to the conclusion that surface conditions do not change during activation. J. P. A.